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HEATING AND LIGHTING RAILWAY CARS

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Heating and Lighting Railway Passenger Cars

Describes in Detail the Various Systems Used to Heat Passenger Coaches—Baker Systems--Gold's Storage System—Hot Water Steam and Electric Systems of Heating. Lighting Passenger Coaches: Acetylene Gas, Safety Storage Acetylene, Pintsch Gas, Electricity. Fully Explained and Illustrated. Comprises also the

MASTER CAR BUILDERS' ASSOCIATION CODE OF RULES

GOVERNING CONDITIONS OF AND REPAIRS TO

FREIGHT CARS

Illustrated with Numerous Engravings and Folding Plates

COMPILED AND EDITED BY

FREDERICK J. PRIOR

Author of "Operation of Trains" and other works

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1912

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AND

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HEATING PASSENGER CARS.

The heating of passenger coaches has always been a problem. At first large stoves were used at each end of a coach and no practicable substitute for stoves was found for many years, notwithstanding the subject exercised the ingenuity and thought of inventors and railway managers from the start. While apparently simple it was really quite complicated, being not merely a question of satisfactorily warming cars, but of preventing danger from fire in case of accident. So great, however, has been the progress made in devising and improving systems of heating, that it seems now as though perfection had been reached. Indeed, the subject of heating passenger coaches may be said to have passed through several stages in its evolution, in exactly the same ratio of progress as many other phases of railway operation. There are now several systems of heating in operation which may be described as follows:

THE BAKER SYSTEM.

To Mr. William C. Baker belongs the credit of having devised the first practicable, scientific system for heating passenger coaches.

When the Baker system was first introduced, the danger from hot coals being scattered, in case of a wreck, had not been removed, as will be seen by reference to Fig. 1, illustrating and describing the first style of heater, some of which are still in use. This is known as the original or old style ordinary Baker heater.

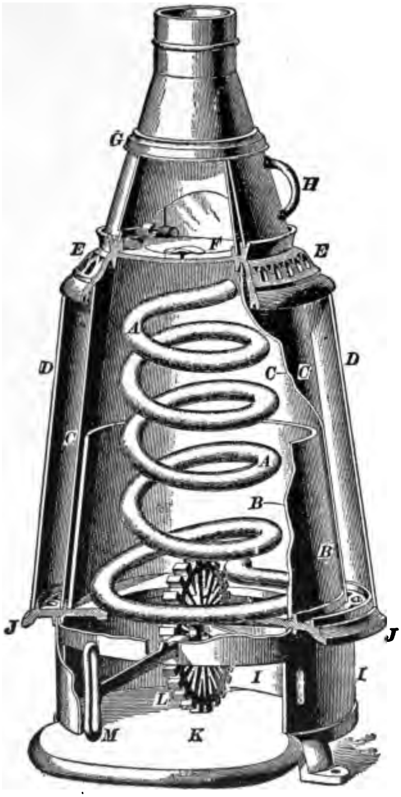


FIG. 1. THE ORIGINAL OR OLD STYLE ORDINARY BAKER HEATER.

A—Generator or Water Coil.
B—Fire-pot.
C—Inside Casing.
D—Outside Casing.
E—Top Casting.
F—Safety Plate.
G—Base of Smoke Flue.
H—Feed-door.
I—Ash-pit.
J—Ash-pit Casting.
K—Base of Stove and Bottom of Ash-pit.
L—Grate in Position to Dump.
M—Rocking Bar and Shaker for Grate.
E J—Perforated Castings Permitting Upward Air Circulation Through Space Between Casings C and D

The air between the casings when heated expands and therefore rises, permitting cool air to be forced in through the perforated holes in the casting J, to take its place, and so an upward circulation of air is maintained. The generator coil A is connected to the heating system and as it is always filled with water (usually salt water or brine) it is heated by the fire and expands rapidly. The water as soon as it expands rises and passes out of the coil at the top, and cooler water passes into the coil at the lower end, taking the place of the heated water, and so an upward circulation is maintained through this coil.

The fire enclosure and water coil comprise the heater, but there are in addition some other apparatus used in connection with the system. These consist of a circulating or expansion drum, radiating pipes, cocks, etc., which serve to carry the hot water and distribute or radiate the heat throughout all parts of a coach.

Figure 2 is an illustration of a circulating drum. This drum is always attached to the highest point of the heater —preferably the roof of the car. It holds the water needed for circulation after the pipes have been filled. It also serves as a reserve tank. It is set horizontally as shown in Figure 3. The position of cock C enables the lower half of the drum to be used for storing water. The upper half is used as an air chamber which serves as an expansion chamber to secure free circulation. The air freed from the pipes after the water is heated rises and gathers in the upper half of the drum. There are two tapped holes in the bottom of the drum, a and b; the upper pipe from the heater enters one and from the other runs the circulating or down-flow pipe which carries the hot water through the car.

Should the fire be allowed to burn unchecked or the water circulation be impeded the pressure in the heater might become dangerously high. To provide for such a contingency an appliance of cast iron called a safety vent, indicated at v in Figure 2, is screwed into the top of the circulating drum. It is a single casting without joints; at the top it is thinned down to a specified thickness which serves as a weak spot to yield, allowing the top to be blown off when the pressure reaches a certain point. More or less water is lost when a top blows off, which should be renewed. As soon as a safety vent blows out the fire should be put out to protect the coil. Of course, when a safety vent top is blown out it should be replaced with a new one, although the bushing may be used again.

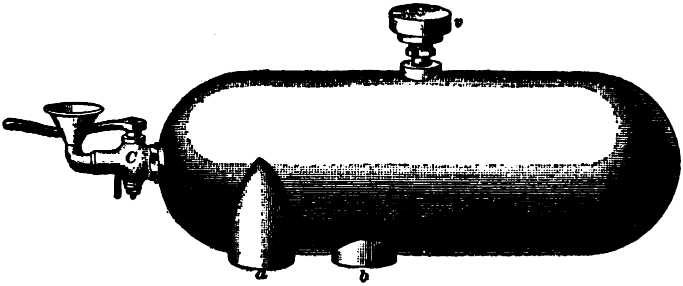


FIG. 2. CIRCULATING DRUM, OR WATER RESERVOIR AND EXPANSION CHAMBER.

V—Safety Vent. C—Cock.
a b—Tapped Holes for the Upflow and Downflow Pipes.

The piping arrangement is shown in Figure 3. The expansion drum D is placed horizontally upon the roof, the heater being upon the floor of the car immediately beneath, as indicated by the coil A. The inflow pipe or riser R conveys the heated water to drum D from which

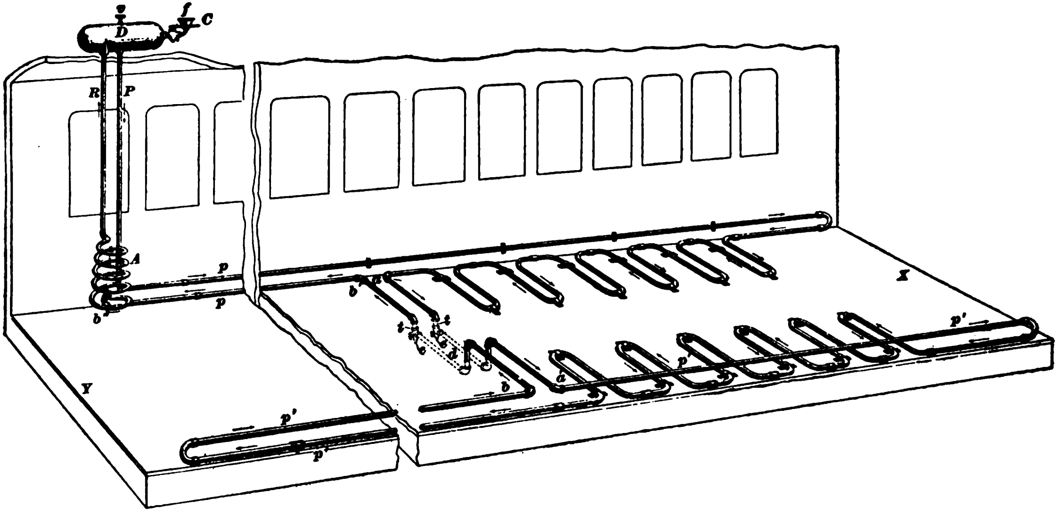


FIG. 3. SHOWING PLAN OF PIPING, COIL, AND CIRCULATION DRUM.

D—Expansion Drum.
R—Riser.
P—Downflow Pipe.
A—Coil (Inside Heater).

P—Piping.
Y—Heater End of Car.
X—Other End of Car.
C—Cock.
f—Funnel.

v—Safety Vent.
e—Position of Drain Cock.
t—Tee Fitting.
d—Space Beneath Flooring.

it descends into the car again through the pipe P and thence on its circuit through the line of piping p to which the pipe P is joined. The piping extends to the other end of the car X and then turns and in a series of loops, each one being under a seat, returns to point a, thence it crosses to the other side. The hot water is thus conveyed from one end of the car to the other, back again in a zig-zag circuit along the same side, thence across the car to the other side, and down the pipe p to X as before, back again as on the other side to the return bend at Y, recrosses the car at b and thence re-enters the heater at the bottom of the coil at b. The course of the circulation is indicated by the arrows. The pipe goes below the floor of the car at d as shown, a tee fitting being placed at t. In order to drain off the water when necessary a drain cock is placed at e. For better elucidation the illustration represents the car broken in two, the two parts being close together.

As the water in pipe R heats and expands, rising into the expansion drum, the water in pipe P being cooler, it weighs more and so exerts a pressure on the water in pipe p, causing it to circulate in the piping and re-enter coil A at its lower end. Passing through the pipes in the fire it is again heated, rises through the coil into the drum and is again discharged through the other pipe leading from the drum to the radiating pipe. Thus a continued up-flow of hot water is maintained through the coil into the drum, and a constant down-flow from the drum to the pipes in the car. The drum is filled through the funnel f and the cock C. After being filled the funnel should be turned downward to prevent dirt or cinders from accumulating in it. The cock is provided with a drip pipe. The foregoing describes the construction, piping and method of water circulation of the ordinary Baker heater, but, as already stated, the danger from hot coals being scattered in case of accident was not eliminated by the introduction of this heater. This led to an

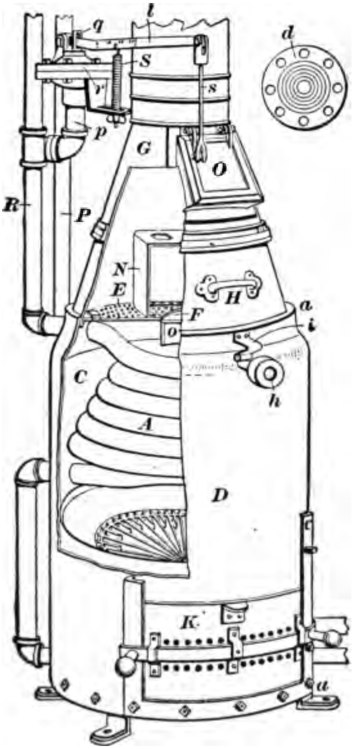


FIG. 4. IMPROVED FIRE-PROOF HEATER.

A—Coil.
K—Ash-pit Door.
G—Smoke Flue Base.
E—Top Plate with Small Holes.
N—Smoke Screen.
o—Coal Feed Chute.
F—Safety Plate.
i—Spring.
D—Fire Safe.
a—Indicating Depth.
C—Sheet-iron Casing.
d—Regulator Diaphragm.

improved or Baker Fire-proof Heater being invented, a description of which follows:

There is a fire-safe consisting of an outside shell or casing made of a flexible grade of steel, without joint or seam. See Figure 4. D is the fire-safe; the depth of the casing or shell is indicated from a to a. On the inside of the shell are sheets of asbestos and next to these layers of asbestos is a sheet-iron casing C, enclosing the coil A; the space between casing C and coil A serves as an air space for the hot gases from the fire, and the space inside the coil A serves as a fire chamber. The fire is accordingly within four casings: (1) A water casing consisting of the closely wound coil A filled with water; (2) a casing of sheet-iron; (3) a casing of asbestos layers; and (4) an outer casing of steel plate.

The small holes in the draft, or ash pit, door K are the only open means of communication between the fire and the outer air; therefore, should the heater have the smoke-flue base G moved in a wreck, the only place through which fire could escape would be through the small holes in the top of E, and as these holes are so small there would be no danger of hot coals escaping.

The smoke screen N is a cone shape casting, as shown in Figure 4 for feeding the coal in at the front, the opening being just behind the feed-door. The coal goes down through the bottom of the casting, thence through the coal feed-chute o into the fire. Safety plate F, which is controlled by the hand lever h (the latter being held in place by the spring i), closes the hole in the bottom of the screen N, the top of which has small holes as shown, for the smoke to pass through.

The different casings which enclose the fire, the safety plate which covers the feed-chute, and the cinder-proof door which closes in the ash-pit, together with the asbestos sheeting between the ash-pit bottom and the sheet-iron bottom of the heater render this style of heater practically fire-proof; because the smoke-pipe and smoke-flue base might be broken off in a wreck without exposing the fire in the fire-chamber, the latter being practically fire-proof.

Another style of Baker fire-proof heater is the "two coil" with a distinct circulation for each side of a car, thus doubling the capacity. See Fig. 6.

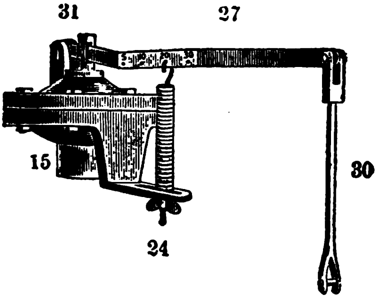


FIG. 5. AUTOMATIC REGULATOR AND PRESSURE INDICATOR.
15—Fire Regulator Bowl.
24—Adjustable Draft Regulator Spring.
27—Regulator Lever and Pressure Indicator.
30—Forked Connection and Door Rod.
31—Piston, Brass Connecting Lever.

The fire-proof heaters just described have an automatic arrangement for regulating the fire according to the pressure in the heater and the temperature in the radiating pipes. It is in effect a draft regulator, as shown by the letter r in Figure 4. It is also shown in detail in Figure 5. It will be seen that a pipe indicated by p leaves the riser R at the point shown and runs into the regulator

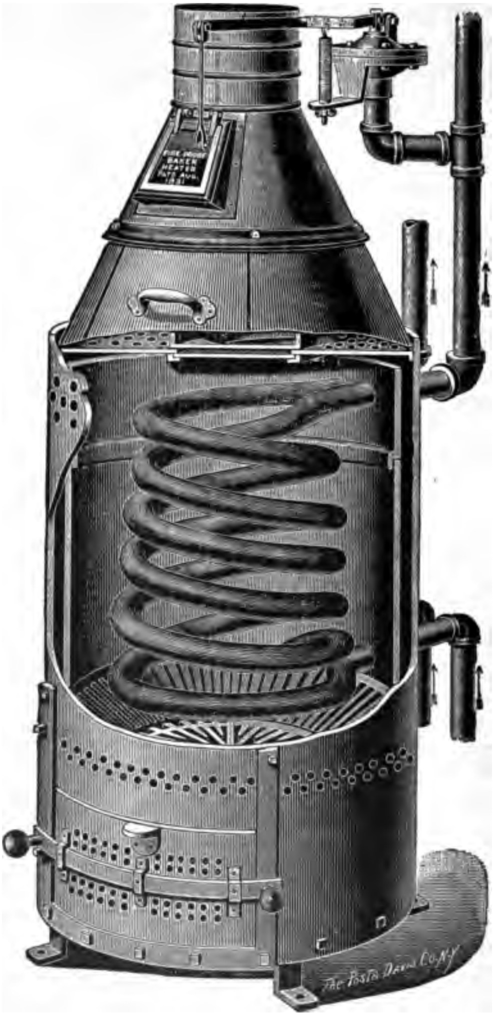


FIG. 6. DOUBLE COIL OR TWO CIRCULATION HEATER.

bowl, which consists of two concave pieces bolted together. Between the two parts of the bowl is a diaphragm d made from corrugated steel, as shown separately at the right. The steel is tempered and has a thin sheet of copper on each side. This diaphragm is bolted between the parts of the regulator bowl as described; the under side of which is exposed to the pressure in the pipe R. The rod q passes through the top of the bowl and rests upon the diaphragm d.

The pressure in R and in the bowl gradually increases, forcing up the middle flexible portion of the diaphragm and thus the rod q is lifted against the action of the spring S and the lever l, and so raises rod s and counter-draft door O, thus checking the draft through the fire. When the pressure in R decreases the diaphragm moves downward, the spring S pulls the lever l down and so closes the door O, causing more draft. The spring S has a loop at the upper end so it may be placed in any of the holes shown in the lever l. The closer to q it is the less force on the diaphragm is required to raise l. Each hole is marked with the pressure at which the door will open when the spring is in it, and this pressure corresponds with the pressure in the heater. Therefore r is really a temperature regulator, because the temperature varies with the pressure.

The water used is preferably salted, almost like brine. This prevents the pipes from freezing when not in use. Fresh water may be used, but it freezes at a temperature of 32° F., so there would be some danger and annoyance likely when starting fires. Salt water has a much lower freezing point than fresh water and the more salt it holds in solution the lower is the freezing point in the temperature. So with the brine properly prepared the pipes will not freeze though the car should stand for several days without a fire and the temperature be 30° below zero. Salt water does not injure the pipes, neither do they rust. Heaters in use for several years have been examined and found free of rust or salt deposits. The brine should be prepared in a barrel or other vessel, and more salt than immediately dissolves should be put in and stirred up occasionally from the bottom; after twelve hours the excessive salt will have gone to the bottom, the water appearing clear above it. The salt deposit at the bottom of the barrel should not be disturbed, only the clear salt water should be used to fill the heater system, which will be salt enough to stand a very low temperature without freezing.

An absolutely solid body of water in the pipes is essential to proper circulation. Therefore all air, dirt and scale should be expelled from the pipes and they should then be filled with water free from air bubbles, as follows:

All draw-off or drain cocks in the circulation piping should be opened, the safety valve removed, and the combination cock kept closed. Then a half-inch pipe should be run from the topmost tapping in the expansion drum as shown at A A, Figure 7. This piping must be absolutely tight. It should be extended down outside the car and connected to the upper end of a coil or pipe in the barrel or tank, the latter being put as close as possible to the car. Coil B should be about 2 inches smaller in diameter than the inside of the barrel and should be coiled as closely as possible to insure a large amount of heating surface. Near the lower end should be a tee (T) fitting shown at a (see (b)) and an angle valve b should be connected to the tee (T) as indicated. A metal strainer c should be attached to the angle valve

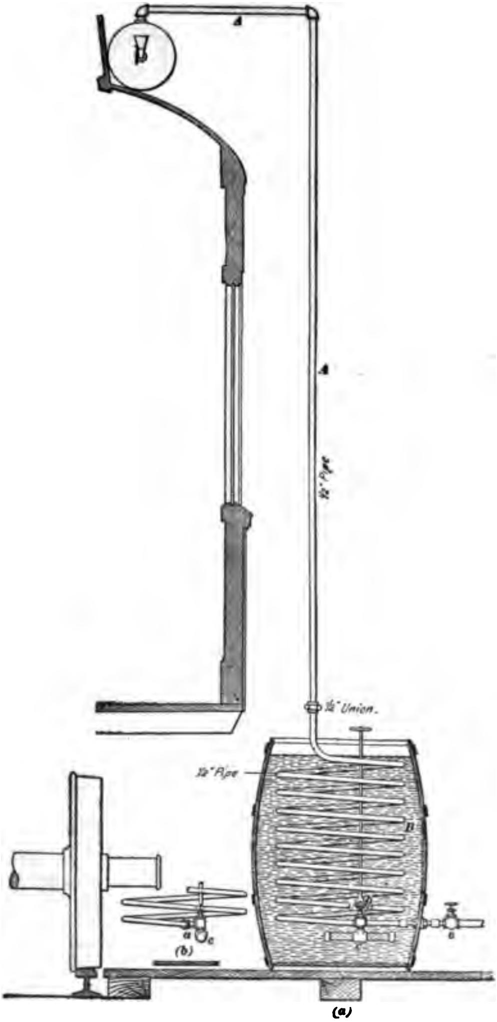


FIG. 7. ARRANGEMENT ILLUSTRATING METHOD OF FILLING THE HEATER CIRCULATION SYSTEM.

to prevent salt or any other solid matter from entering the pipes. The lower end of the coil should be connected with the Globe valve e. The water, if salt, should be sufficient to fill the pipes without drawing down too close to the surplus salt at the bottom and not too near to the strainer. The water level should never be less than four inches above the strainer. One hundred feet of 1¼-inch piping will hold about seven and a half gallons of water; therefore, if the number of feet of circulation piping is known the quantity of water can easily be calculated. As a precaution an excess quantity of about a third should be provided. A barrel of the ordinary size will usually hold enough water to fill the heater in a standard car; and the same quantity suffices for one-half of a double circulation heater, but to guard against taking air into the pipes care should be taken to have more water or brine than is absolutely needed so as to not draw it down too near to the strainer.

The angle valve b should be closed and the globe valve e opened; a steam hose connected to the draw-off cock furthest from the expansion drum and about 25 or 30 pounds of steam blown into the pipes. Directly it issues in full volume freely from each open draw-off cock that cock should be closed, and thus in the course of a few moments every foot of the heater pipes will be full of live steam which will force its way into the expansion drum and out through the coil B and the globe valve e, carrying the air and the condensed water with it, which will be discharged from the globe valve e. Should any live steam escape with the water, the valve should be closed a little, or until nothing but water and air escape. The steam will heat the water in the barrel to the boiling point when all the air has been expelled;

and boiling will expel the air held in suspension in a body of cool water; then, if the boiling water will float a potato it is salt enough to use in the circulation pipes.

The globe valve outside the barrel and also the draw-off cock through which steam enters the pipes should be closed and the steam hose disconnected. The angle valve inside the barrel should be opened, whereupon the steam from the pipes will continue to enter the brine until the pressure is reduced. The steam which remains in the pipes will condense and form a vacuum into which the boiling hot brine is forced by atmospheric pressure, completely filling the pipes in a few moments. It may be known the pipes are completely filled by the water level in the barrel remaining stationary.

The half-inch piping should be disconnected after the circulation piping is filled, whereupon it will be discovered the drum is full to the top. This excess may be drawn off through the combination cock to the level of the cock and then the safety valve should be replaced. When, after a few hours, the water has cooled, it will have contracted to some extent, so a small quantity may be added by hand through the combination cock. The heating system will then be ready for service. In the case of double-coil circulation systems they should be treated as though each were a separate car.

The fire should be started slowly when first it is lighted, it is best to begin with a wood fire. It should burn gradually until the circulation of the hot water is complete, which is indicated by the entire piping system being hot. Then the fire should be allowed to die down and the water to cool. Probably two or three firings and coolings may be necessary before all the air is exhausted from the pipes and the water becomes "solid."

Usually after the first firing the heater needs more water. For the first few days the renewing of water should be carefully attended to, a small deficit may have to be made good every day for the first week or two. When, however, the water becomes solid throughout the heater and circulation pipes no further renewal will be necessary; but nevertheless frequent tests should be made to ensure that everything is working right.

To test for the amount of water in the drum and piping the fire should be low and no pressure in the heater. The height of the water in the drum should be noted by means of the combination cock C, Figure 5. If the water is at the right height it will run out of the drip pipe when the cock C is opened. To renew water when necessary to do so, it should be put in through the filling funnel f, which is attached to the cock C. When through the cock should be closed and the funnel turned down.

To empty water from the heating system, if occasion requires, it should be drawn off through the cock e in the crossover pipe, Figure 3. At the same time cock C in the drum should be opened to serve as an air vent, thus admitting atmospheric pressure to assist in discharging the water more freely. Should there be any extra drain cocks where water could be pocketed in the piping they should be opened also to drain out the water. The circulation system should never be emptied unless absolutely necessary.

If the water should ever be allowed to get low enough so that the drum is emptied, circulation will stop, the pressure will increase rapidly, and the safety vent probably blow out. Should it get so low as to leave none in the coil the latter would burn out; but if the water is always kept solid the circulation throughout the entire system will be satisfactory, without any pressure in the heater. Should a safety vent blow out, the fire should be immediately drawn, the water renewed to the level of the combination cock C, another vent v screwed into the drum and the fire again started.

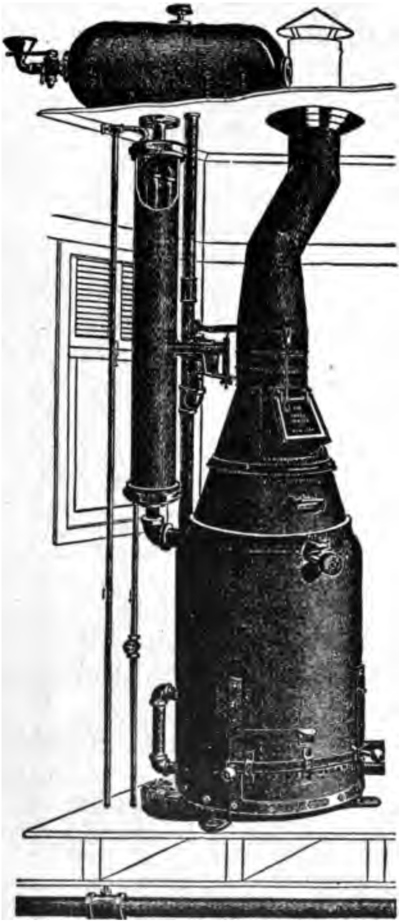
On the old style Baker heater the safety vent consisted of a rubber ball held between two brass plates. The screws which hold these plates must not be interfered with nor should the plates be screwed any closer together than was originally intended. Every time the valve blows out it spoils the ball, therefore a new one should be put in, but the cast-iron vent is far more reliable.

The pressure gauge indicates the pressure within the heater.

The New Style of Baker Heater Steam Attachment consists of four ¾-inch copper pipes screwed into brass fittings, and placed vertically into a 3-inch wrought iron cylinder, three and one-half feet long. Into this cylinder steam is admitted from the locomotive through a ⅜-inch branch pipe leading up from the train pipe, to top of cylinder. By this arrangement, steam instead of fire in the Baker heater is used, if desired, to circulate the water, or steam can be used at the same time as the fire, to heat up quickly.

When used in connection with a heater, it is placed at the back of the heater, as shown in Figure 8, between the return pipe and the pipe connecting top of the coil to the drum. (The heater coil can be cut out if so desired.)

The steam is controlled by an angle valve, placed at the top of the ⅜-inch supply pipe. The position of the valve is such that all water from the condensed steam will run from it.



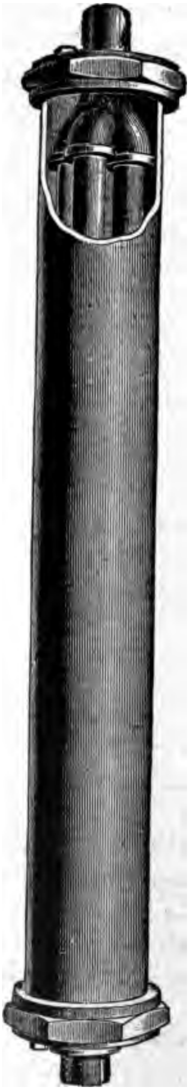


FIG. 8. BAKER STEAM ATTACHMENT SHOWN FITTED TO HEATER. CUT TO THE RIGHT SHOWS THE ATTACHMENT DETACHED *FROM* HEATER.

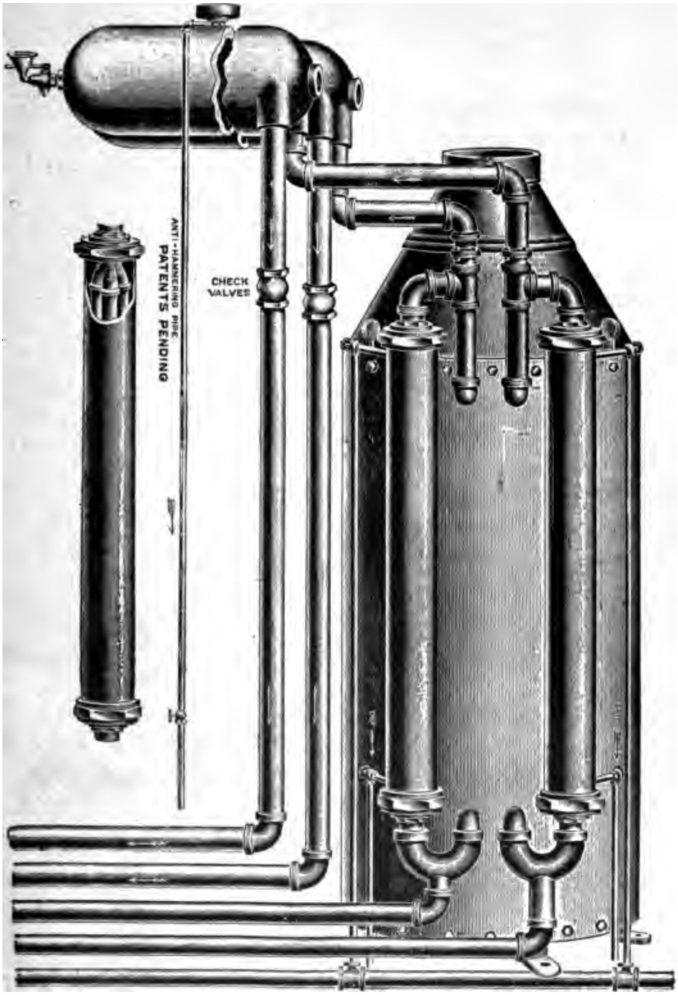


FIG. 9. DETAILS OF IMPROVED BAKER STEAM ATTACHMENT.
(See Fig. 8 for Same Shown Attached to Heater.)

No "trap" is used for the release of the water of the condensed steam, but instead a simple blow-through valve on a ⅜-inch drip pipe, operated inside the car. The seat of this valve has a small groove, which allows the escape of condensed water, even if closed.

A check valve is placed in the feed pipe between the drum and the radiating pipes, insuring positive circulation in the right direction when the heater coil is cut out.

An anti-hammering pipe is connected to the top of the circulating drum to relieve any air pressure which thereby prevents the hammering.

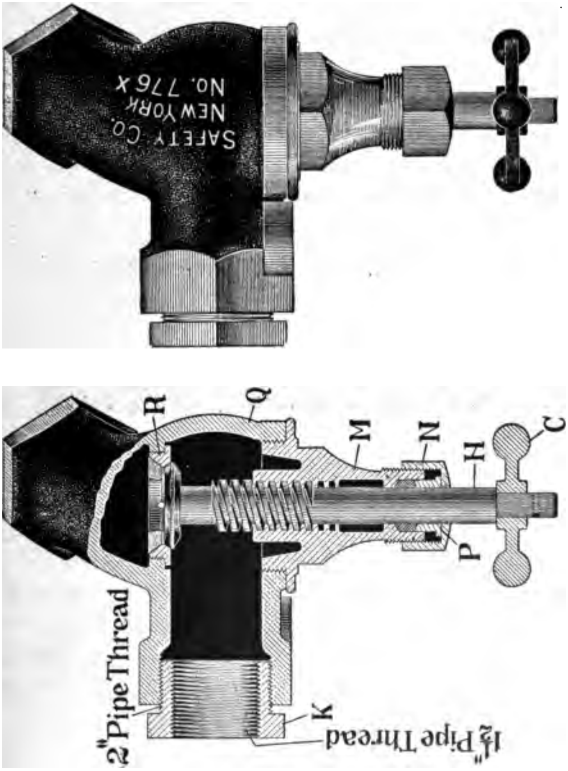
In using this steam attachment in connection with a double coil heater, each side works independently of the other.

It is claimed that circulation is obtained in 40 minutes, with only 15 or 20 pounds of steam, and that best results are obtained by turning steam on slowly at 5 pounds —and up to 15 or 20. After circulation is complete, it is said to require but from 5 to 7 pounds to maintain.

The steam attachment can also be used independently of any heater in connection with the expansion drum and hot water radiating pipes. When used independently of the heater, an attachment (jacketed with asbestos covering) can be placed on each side of the car, if desired, thus doing away with the "cross-over," which, it has been asserted, is a very objectionable feature in car heating.

STANDARD HEATING SYSTEM.

This system has as its basis the ordinary hot water circulating system, with the Baker heater stove. The heat of the fire in the stove being replaced with steam drawn from the locomotive; of course the fire in the Baker heater stove may be started whenever necessary. To use the steam thus drawn from the locomotive steam jackets are used, one being located near the heater, on



Plan

Section

FIG. 10. TRAIN PIPE VALVE.

C—Hand Wheel. K—Bushing. N—Gland Nut. Q—Body.
H—Stem. M—Bonnet. P—Gland. R—Removable Seat.

the pipe which leads to the bottom of the coil, the others on the pipes which lead to and from the radiating pipes on the side of the car opposite the heater side, known as "cross-overs," or, in the case of a double circulation car they are connected into the circulation near the middle of the car. The steam thus drawn from the locomotive is conducted from car to car by means of suitable flexible couplings and pipes beneath the floor; these pipes are called train-pipes, and they are so arranged as to admit of gravity drainage from a selected high point to each end of the car. A fitting is placed at this high point which permits the necessary quantity of steam to be withdrawn from the train-pipe for use in heating the car. Two train-pipe valves, Figure 10, one at each end of the car, control the passage of steam through the pipe, both being kept open, except the one at the rear end of the rear car, which should be closed to prevent the steam from escaping. A small groove in the seat of the valve provides for the continual draining of the condensed steam (or water) and prevents freezing. The train-pipe valves just described are controlled by extension handle, Figure 11, which is readily reached from the car step.

FIG. 11. EXTENSION HANDLE.

From the fitting in the train-pipe steam passes first through a controlling valve, near the heater, along the truss plank to the low end of the jacket nearest the heater and from this jacket by connecting pipes to the other jackets in series. These jackets have each an inclination upward in the direction of the circulation of the water, steam entering and leaving the low end of each jacket. The steam pipes should maintain a gradual fall from the controlling valve to the low end of the last jacket and then to the automatic trap.

In all jackets the water contained within the outer pipes is heated by the passing steam, thus aiding in the circulation, and also reducing to from one-third to one-sixth the time required to cause complete circulation of hot water in all parts of the system. While the steam at the pressures used is far below the temperature of fire, its application in this way, at various points of circulation instead of at one point (the heater coil), results in a more uniform heating, and higher average temperature of the pipes throughout the car. The principle is the same in a double circulation car, the only difference being in the location of the jackets, which are connected into the circulation as shown.

It will be noted that the entire water circulating system is a "closed" one, and that when once filled with water to the proper level, requires no further attention.

The heat required for the car is regulated by a controlling valve which admits steam to the jackets, and by which means a uniform temperature is easily maintained.

To discharge the condensed steam (or water) from the steam pipes, and yet prevent steam from escaping, an automatic steam trap is used, Figure 12. This trap is adjusted by loosening the locknut F, on the end, the trap is then opened by screwing out the seat (which is controlled by the smaller square stem D) until steam escapes freely, then it should be closed until a point is reached where just a little steam escapes with the water. When the seat is adjusted properly the locknut should

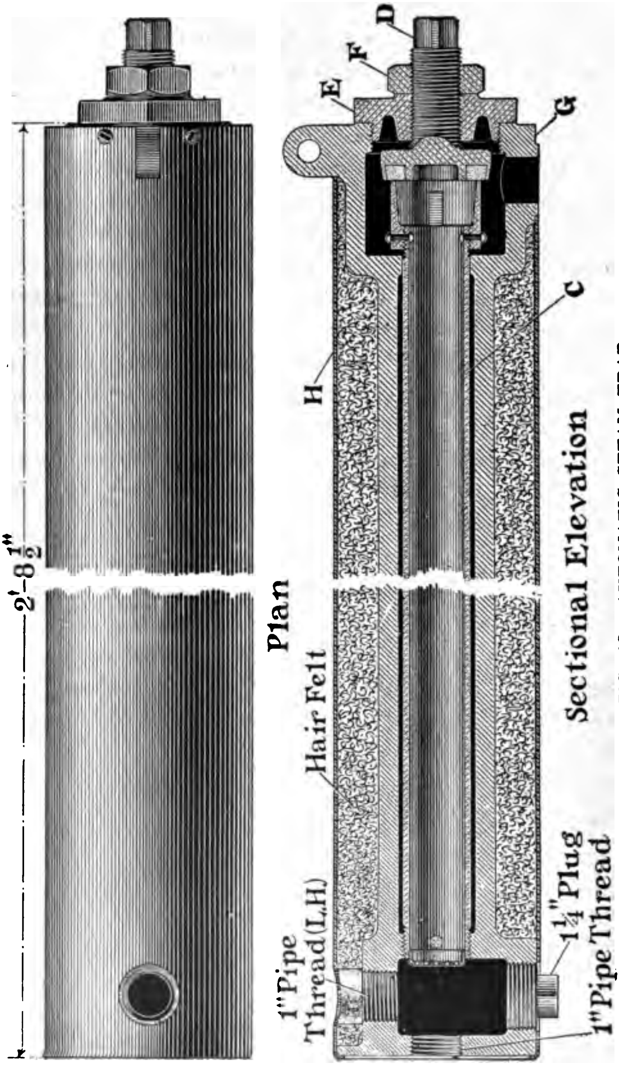


FIG. 12. AUTOMATIC STEAM TRAP.

C—Pipe and Valve.
D—Valve Seat.
E—Bushing.
F—Locknut.
G—Body.
H—Cover.

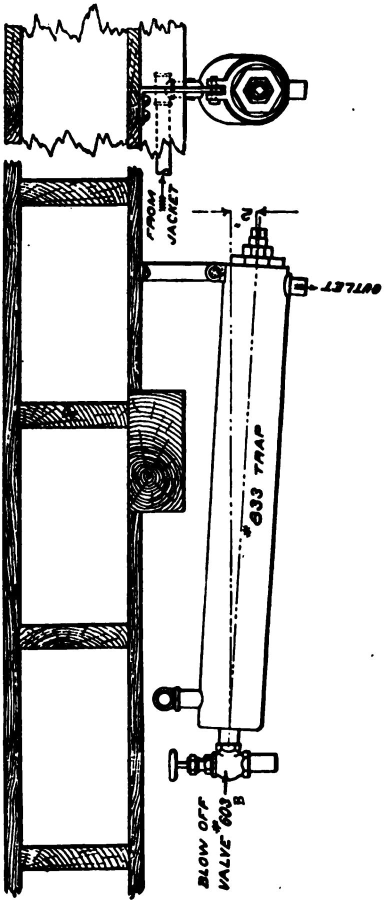


FIG. 13. DIAGRAM SHOWING MINIMUM PITCH TO BE GIVEN TO STEAM TRAP (FIG. 12) AND ALSO THE BLOW-OFF COCK SHOWN CONNECTED.

tightly screwed up, care being taken not to let th at move while doing so.

The minimum pitch which should be given to the tra ensure that the water of condensation drains througl e outlet is shown in Figure 13, which also shows blow-off valve connected to the one-inch pipe thread the end of the trap. This valve serves to remove a dirt or scale from the trap, and it also permits the qui discharge of condensed steam. It is usually so arrang that it may be controlled by an extension handle throu the floor of the car.

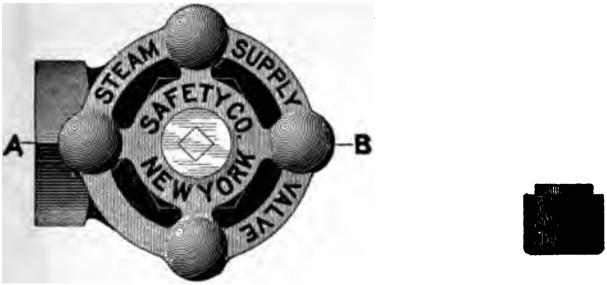
Should steam be entirely cut off at any time, the tr will immediately discharge all condensation which mains in the pipes. Or, it may be quickly discharged means of the blow-off valve above the trap, which generally controlled by a handle through the floor. T trap is fully capable of being used without recourse this auxiliary, it is merely there for use in the event most extraordinary and very severe conditions.

DIRECT STEAM HEATING SYSTEM.

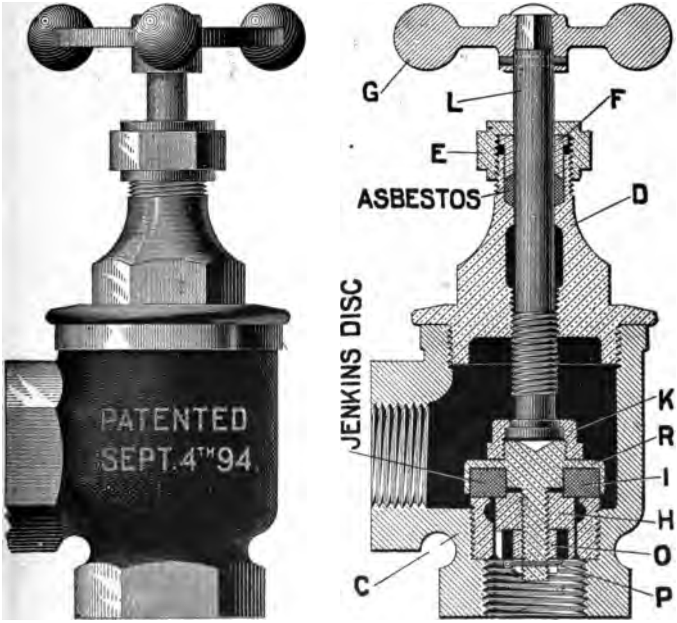
This system, illustrated by Plates I, II and III, is simple and easily applied heater for cars. It is illustrat on Plate III.

Steam is supplied to the cars by means of an ordina train-pipe, with flexible couplings between the cars. Th train-pipe drains from the center to each end of the ca and at the middle point is a cross, 638.

Two train-pipe valves, one at each end of the car, co trol the passage of steam through the pipe, both bei kept open, except the rear one of the rear car, which closed to prevent the escape of steam. A small groove the seat of the valve provides for the continual draini of the condensation in the train-pipe and avoids freezi These train-pipe valves are controlled by extension ha dles, which may be readily reached from the steps of t car.



PLAN VALVE



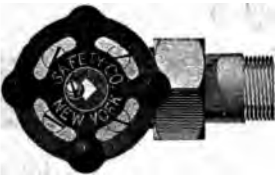
ELEVATION SECTION A B

FIG 14. STEAM INLET VALVE.

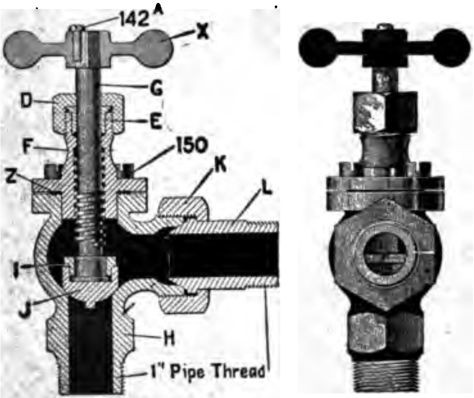
LIST OF PARTS.

C—Body.
D—Bonnet.
E—Cap Nut.
F—Gland.
G—Hand Wheel.
H—Valve.
I—Disc.
K—Stem Nut.
L—Stem.
O—Valve Nut.
P—Cotter Pin.
R—Disc Case.

Steam is supplied from the train-pipe through t cross, 638, and it passes to each side of the car. Risi through the floor beneath a seat, it is controlled by



Plan



Section

Elevation

FIG. 15. ANGLE VALVE.
(Used on Locomotive.)

D—Cap Nut.
E—Gland.
F—Bonnet.
G—Stem.
H—Body.
I—Stem Nut.
J—Valve.
K—Union Nut.
L—Union Nipple.
X—Hand Wheel.
Z—Gasket.
No. 142A—Retaining Screw.
No. 150—Bonnet Screw.

steam inlet valve, Figure 14, which is capable of very f adjustment. By means of this valve the requisite amou [illegible]*f steam* necessary to heat the car is admitted.

Along the truss plank is a radiator of two (2) inch pipes, and the steam from the inlet valve enters the upper one first through a back outlet return bend, 783, and expansion bend. This 2-inch pipe has an inclination from the center toward each end of the car, and the steam follows these inclinations, entering the lower pipe from the ends and returning toward the center. At the center is a tee, 708b, from which a 2-inch pipe is taken to a vertical automatic trap, which regulates the discharge of the condensation.

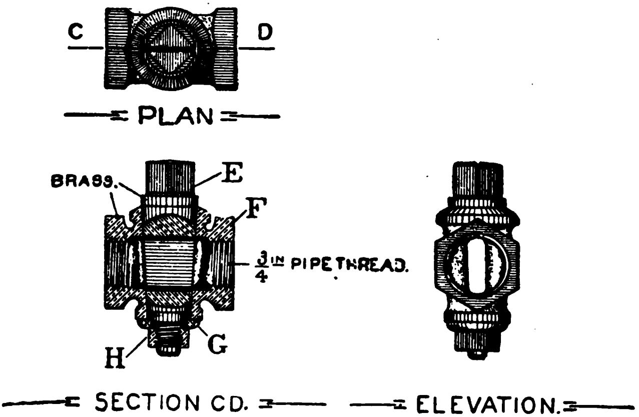


FIG. 16. REDUCING VALVE.
(Used on Locomotive.)

E—Plug.
F—Body.
G—Washer.
H—Nut.

The radiation of the heat from the two pipes along the truss plank heats the car, the area of radiating surface being proportioned to the size of the car.

Plate IV illustrates in a general way the method of equipping a locomotive for use with steam heated cars. Steam is usually taken from the "steam box."

Angle Valve, Figure 15, Reducing Valve, Figure 16, and Gauge, Figure 17, are placed in the relationship shown on the drawing. The first is for admitting the steam supply, and the Reducing Valve is for controlling the pressure on the Train-Pipe and should never be used as a shut-off valve.

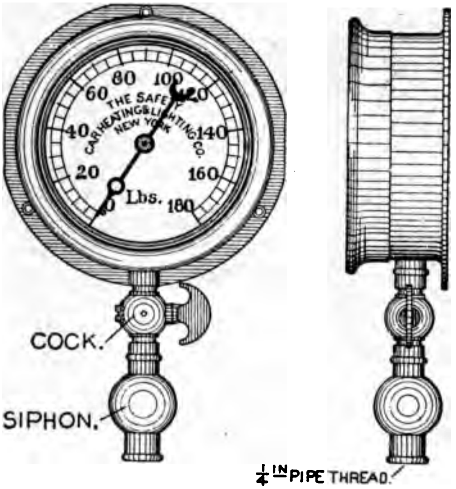


FIG. 17. GAUGE FOR STEAM HEATING.
(On Locomotive.)

Experience has shown that it is best to carry a pressure of 40 lbs. on the train-pipe for a train of eight cars or less, and that for a greater number of cars, the pressure should be increased five pounds for each car above eight. It is better to have a pressure higher than is needed than one that is too low, and it is *not* a serious drain on the locomotive. The amount of extra work put on a locomotive, by the steam heating of its train, is measured by the amount of water condensed by each car, and is roughly about 40 to 60 lbs. per hour per car.

Care should be taken to keep the steam gauge, Figure 17, in good order, and it should be tested and corrected, if necessary, at least once each season. Many cases of reported failures of trains to heat properly are found to be due to errors of gauges, the pressure actually supplied being far below that indicated by the gauge.

STEAM COUPLER TROUBLES.

Owing to modern passenger traffic conditions, with the constantly increasing demands made on locomotives, improvements to prevent leaks and effect economy of steam have been made and upon many railroads have been adopted. We give, therefore, a concise description of new style steam couplers made by the Consolidated Car Heating Company.

Serious steam losses result from imperfect connections of steam hose couplers. Constant efforts have been made to construct a satisfactory coupler. Coupler heads are hammered together, and locking devices are applied in an attempt to force a tight joint—and still the drain on the locomotive has increased and the delays to trains on account of leaky couplers have been as frequent and annoying as ever.

The Consolidated Car-Heating Company claim to have overcome this condition by the development of the type of coupler we describe (see Figure 18). The essential points in the construction of this type of coupler are: (1) an automatic locking device, (2) all the points of engagement are carefully machined, (3) the opening through the head can be adjusted from 1¼′ to 1½′, (4)

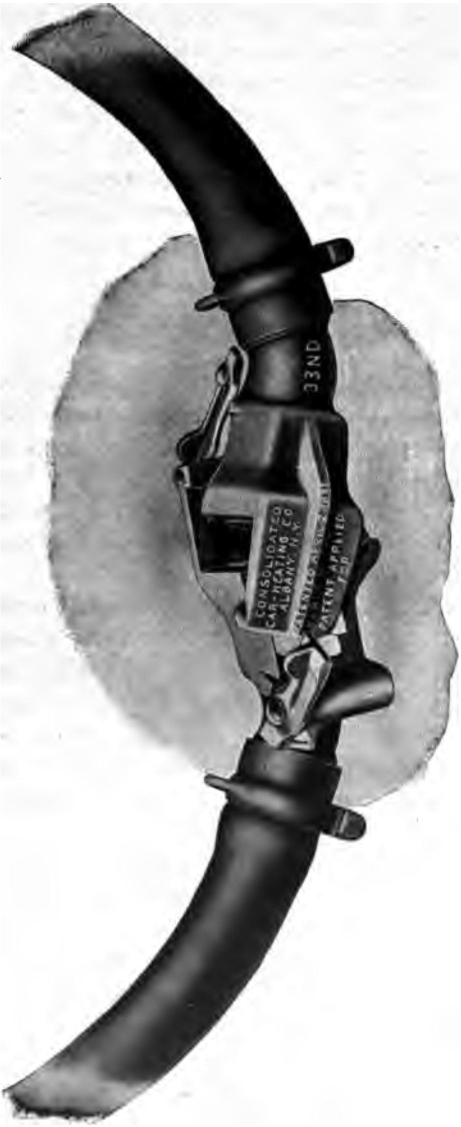


FIG. 18. COUPLING OF HEADS.

the liability to hose kinking is prevented by the increased angle of the coupler nipple, (5) should the train part the coupler automatically separates, (6) on sharp curves or under strain of the draft rigging the coupler will not open and leak steam, (7) the wear and gasket losses are reduced to a minimum through the novel and efficient method of holding gaskets.

The gasket is applied to the coupler by sliding it into the machined groove, and is firmly locked in place by slightly bending the steel lug formed on it. Springs are not used to hold it in place, neither are they necessary, because there is no obstruction in the steam passage. It is moulded into one piece and has wide faces at the front and back, making a positive seat and steam tight joint.

When a coupling of the heads is being made, the locks are turned to one side so that the lug and clutch can engage each other. The locks are then snapped into position (see Figure 19).

The small degree of lift of the heads with the attending slight bend of the hose in the coupling will be noted. This feature is the result of the increased angle of the coupler head nipple. It produces the important advantage of ease in making the coupler connection, of effecting a more positive automatic coupling, and of greatly lessening the amount of bending at the hose when coupling and uncoupling. It is the bending of the hose which proves so destructive to its life—especially in regard to the larger sizes. The increased angle of the nipple permits of a natural set form to the hose when coupled. The bending strain is distributed over the entire length of the hose instead of being confined to the point just back of the nipple and causing kinking, as is the case when the angle of the elevation of the nipple is less. The service application of the coupler locks is shown in Figure 19 and is as follows: Points A and A¹ acting as fulcrums, through the compression of the specially oil tempered spiral steel springs, B and B¹, cause the locks to exert a downward pressure of 35 to 40 pounds at the extreme tip of each of the coupler wings, C and C¹. Point D acting as a hinge, the two gaskets are brought into definite and fixed contact, and a steam-tight connection is effected.

The automatic locking device is, perhaps, the most important feature in the effective operation of this coupler; it is claimed for it that, a steam tight joint is insured under all conditions, that the gaskets are brought together and locked as one piece, that when coupled with heads of other types the locking effect is interchangeable, that heads are prevented from lifting and leaking on sharp curves or under strain of draft rigging, that the necessity of hammering heads in an attempt to get tight joints is entirely done away with, and that in event of the train parting for any cause there is no tearing out of hose or pulling out of train line.

In case of accidental break-in-two of the train the coupler wings are forced up by the straightening of the hose, D acting as a hinge, and the pressure of the lock springs B and B¹ being overcome until the line of draft reaches a higher plane than the line of contact, when the coupler heads part without damage to hose or train line.

THE ECONOMY CAR HEATING SYSTEM.

This system is designed to heat passenger trains with the *exhaust steam* from Air Pumps *instead* of *live steam* from the locomotive boiler.

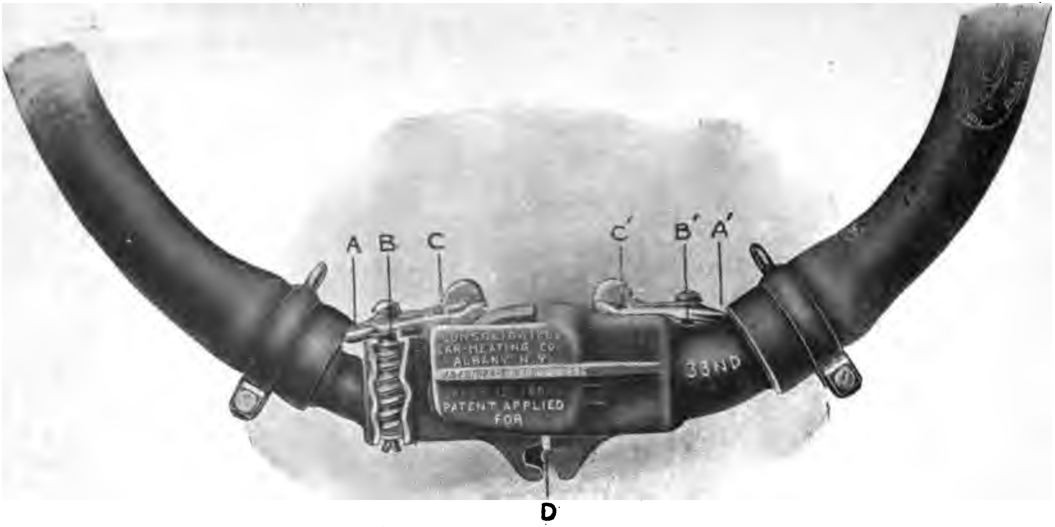


FIG. 19. ACTION OF THE LOCKS.

Many attempts have been made in the past to utilize the exhaust steam from Air Pumps for heating purposes, but without success, as no means were provided for taking care of the condensed water discharged from the pump with the steam. The manufacturers state that the action of the Air Pump on the road being *intermittent,* constantly stopping and restarting, and so causing considerable condensation to take place in both the steam cylinder of the Air Pump and its steam supply pipe, which, being discharged by the Air Pump upon each restarting, can, if carried into the heating system of the cars, fill the radiators and pipes and so prevent the cars from being properly heated. Serious damage would also be likely to result from the freezing of this water in the car radiators and pipes.

With the Economy Car Heating System the exhaust steam and water from the Air Pump is discharged into a *Reservoir,* and the water is prevented from passing into the train pipes and radiators. In the Reservoir also all the *water* is *re-evaporated into steam,* and both the *heat* in the *steam* and the *latent heat* in the *water* exhausted from the Air Pump (which has heretofore been *wasted*) are used for *heating* the cars.

It has been fully demonstrated, the makers claim, on a large number of railroads, on which this system is in use, that the average passenger train can be properly heated with the exhaust steam from the Air Pump *without the use of live steam.*

In case the exhaust from the Air Pump should not be sufficient to heat the train, *live steam* to supply the deficiency is *automatically* drawn from the locomotive boiler. This condition might arise with limited express trains making but few stops, or with very heavy trains in extremely cold weather. In this event, *all the heat* from the Air Pump exhaust would be *utilized,* and the boiler would furnish *only the excess* quantity of live steam necessary to heat the train.

This system is claimed to be *perfectly automatic* and *requires no attention* on the part of the engine crew on the road. The "Relief Valve" is set at the maximum and the "Pressure Regulator" at the minimum pressures before the train is started, and the steam pressure in the train heating system is absolutely confined between these two pressures.

Fuel and water are also saved by the removal of the Air Pump exhaust from the stack, it being a well-known fact that the discharge of the exhaust steam from the Air Pump into the stack, which is the practice on many railroads, causes a *constant draft on the fire* and a considerable *waste of coal.* Steam and water are also wasted by the frequent opening of the pop valves and the operation of the injectors to maintain the proper water level.

The *noise* from the Air Pump exhaust is *avoided,* which is an advantage of no little importance, especially with locomotives standing under covered stations.

A very perceptible improvement in the *steaming* of locomotives has resulted, it is stated, from their equipment with this heating system, especially in the case of locomotives that had previously *steamed poorly* in cold weather. This has been due to the fact that practically all of the steam generated in the boiler has been available for use in the locomotive cylinders, and the constant *drain of live steam* for heating trains has been *eliminated.* Locomotives have, therefore, been able to make their time, and the delays caused by "low steam" have been avoided.

No change whatever is required in the *car heating equipment,* the apparatus being applied to the locomotive in a manner for use in conjunction with the car heating system already in service, which can also be used *independently* of the Economy Car Heating System, with live steam direct from the boiler, if desired.

The effect upon the Air Pump from its operation under back pressure is the same only as would result from an increase of the main reservoir pressure.

PIPE CONNECTIONS.

One set of the Economy Car Heating Apparatus consists of a Reservoir, Three-way Cock, and "E. C. H." Relief Valve.

Various types of locomotives require different locations of the apparatus. The material for the pipe connections depends upon the respective locations of the Air Pump and Reservoir.

Pipe of the *1 1/4 inch size* should be used.

The Reservoirs are made in four sizes, 44 inches in length, and 14, 16, 18, and 20 inches outside diameter respectively, of *steel,* carefully tested under 250 pounds pressure. They are first covered with asbestos cloth, then lagged with wood one inch thick, and fitted on the outside with an iron jacket.

The largest size of Reservoir that will clear the cab line should be used, especially for locomotives hauling long or heavy trains. For trains consisting of not more than four cars a Reservoir of the 14-inch size is amply large.

The Reservoir should be attached to the running board *directly under the cab* and on the *same side* of the locomotive as the Air Pump, so that the pipe connecting the Air Pump and the Reservoir will be the shortest possible. The location of the Reservoir on the same side of the locomotive as the Air Pump is not absolutely necessary, and, in case the driver brake auxiliary reservoir, triple valve, signal valve, etc., are on the same side of the locomotive as the Air Pump, the Reservoir may be attached to the running board directly under the cab on the opposite side, and the exhaust pipe from the Three-way Cock carried back into the cab, across the boiler butt, and down through the running board into the Reservoir.

If the space on both sides is already occupied and it is impossible to locate the Reservoir below the running board directly under the cab, and on locomotives having the Wooten type of firebox, the Reservoir should be attached below the running board *forward of the Air Pump.*

The Reservoirs have two openings in one end and one opening in the other end. The Reservoir with the end having the *two openings* should be placed at the *forward* end, and the *single opening* on the *rear* end should be at the *lowest point.* A pipe should be connected from the *single opening* on the rear end of the Reservoir direct to the train heating pipe under the locomotive tender.

The Three-way Cock should be located in the exhaust pipe of the Air Pump and *close to it*, fitted with a rod leading back into the cab and a handle convenient for operation by the engineer (see Figure 20). A pipe should be connected from the Three-way Cock to one of the openings in the *forward* end of the Reservoir. Quarter-turns and tees should *not* be used with the pipe leading from the Three-way Cock to the Reservoir, but the pipe should be *bent* if necessary. A pipe should be connected from the other, or third opening in the Three-way Cock to the stack or saddle as heretofore.

A pipe should be connected from the direct steam pressure regulator to one of the openings in the *forward* end of the reservoir, and from this same pipe a pipe should be connected to the "E. C. H." Relief Valve. A pipe should also be connected from the "E. C. H." Relief Valve to vent the surplus steam either through the roof of the cab or forward into the saddle or stack, as may be *preferred.*

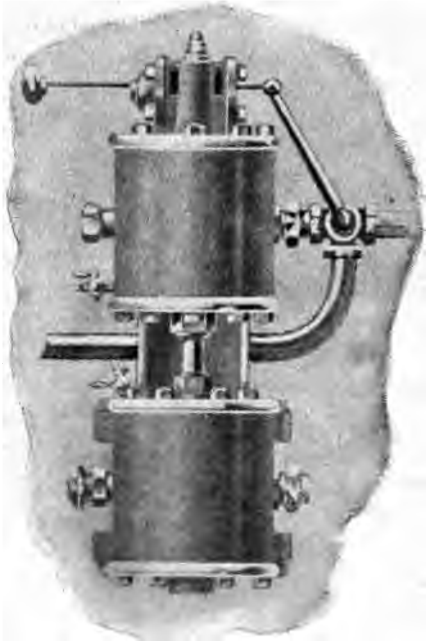


FIG. 20. SHOWS THE THREE-WAY COCK LOCATED IN THE EXHAUST PIPE CLOSE TO THE AIR PUMP, WITH THE OPERATING ROD LEADING BACK INTO THE CAB.

OPERATION.

Before the train is started adjust the Pressure Regulator for the *minimum* pressure and the "E. C. H." Relief Valve for the *maximum* pressure required to heat the train. The steam pressure on the train heating system will therefore be confined between these two pressures.

Pull back the handle of the Three-way Cock, to discharge the exhaust steam from the Air Pump into the Reservoir, and open the boiler valve in the direct heating system.

To shut off the steam from the train, close the boiler valve and push the handle of the Three-way Cock *forward* to discharge the exhaust from the Air Pump into the stack or saddle.

The Three-way Cock must be kept in either the *extreme forward or back position*, as any intermediate position would close the exhaust pipe from the Air Pump.

To increase the pressure on the train heating system, slacken the Cross Bar Check Nut of the "E. C. H." Relief Valve and turn the hand wheel from *left* to *right;* to decrease the maximum pressure, turn the hand wheel from *right* to *left* and tighten the Cross Bar Check Nut.

It will be found that average trains can be properly heated with the exhaust steam from the Air Pump without opening the boiler valve in the direct steam heating system. In case, however, the Air Pump exhaust is not sufficient to maintain the required pressure, open the boiler valve and the Pressure Regulator will furnish live steam to supply the deficiency.

The locomotive shown in Figures 21 and 22 has the air pump and Economy Car Heating Apparatus on the

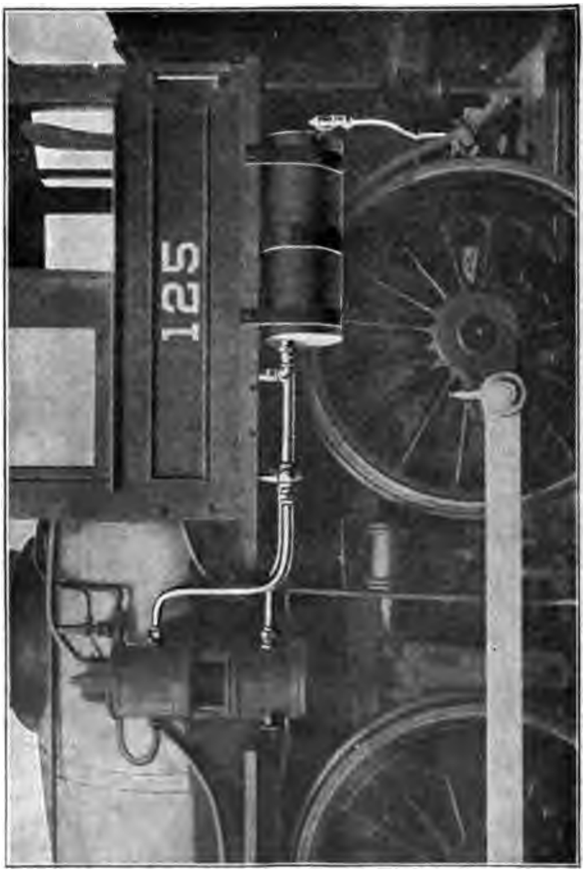


FIG. 21. SHOWING LOCATION OF APPARATUS.

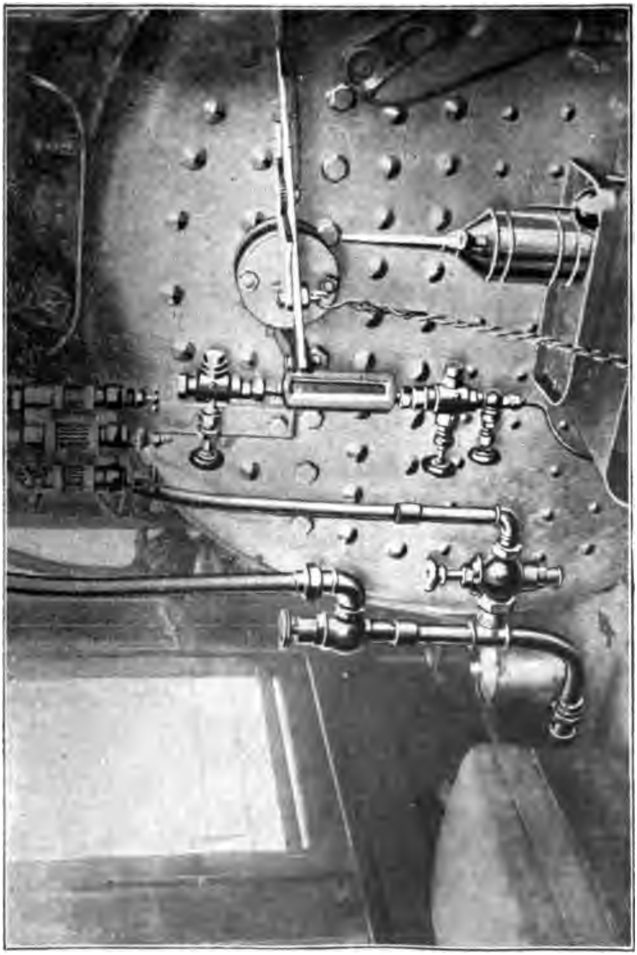


FIG. 22. SHOWING THE PIPING OF ECONOMY CAR HEATING APPARATUS.

left hand side. The three-way cock is located near the reservoir directly under the cab. The outlet of the "E. C. H." Relief Valve is piped to discharge the surplus steam through the roof of the cab. The locomotive shown in Figure 23 has air pump and Economy Car Heating Apparatus on the left hand side, with the three-way cock forward of and close to the air pump, and the exhaust pipe leading to the reservoir fitted with asbestos covering.

When the Economy Car Heating System was first introduced, an ordinary open pop valve located outside, on top of the locomotive cab, was used as a relief valve to vent the surplus pressure from the train heating system. Experience demonstrated that an adjustable relief valve, conveniently located for operation by the engineer inside the cab, was both desirable and necessary to enable him to vary the steam pressure to suit trains of different lengths. A steam pressure of 20 pounds would be ample to heat a train of two or three cars, but a steam pressure of 40 pounds or more might be necessary to insure a circulation of steam at the rear end of very long and heavy trains, especially in extremely cold weather.

The "E. C. H." Relief Valve, illustrated Figure 24, is an improved form of valve with *duplex spring*, especially adapted for the Economy Car Heating System, for which United States Letters Patent have been applied.

The "E. C. H." Relief Valve is located inside the cab, with its pipe connections so arranged that the surplus steam from the train heating system will be discharged either through the roof of the cab or into the saddle or front end of the locomotive, if it is desired to avoid the noise and annoyance of the escaping steam.

Its peculiar merits over all *single spring* relief valves are the increased range of steam pressures at which it will

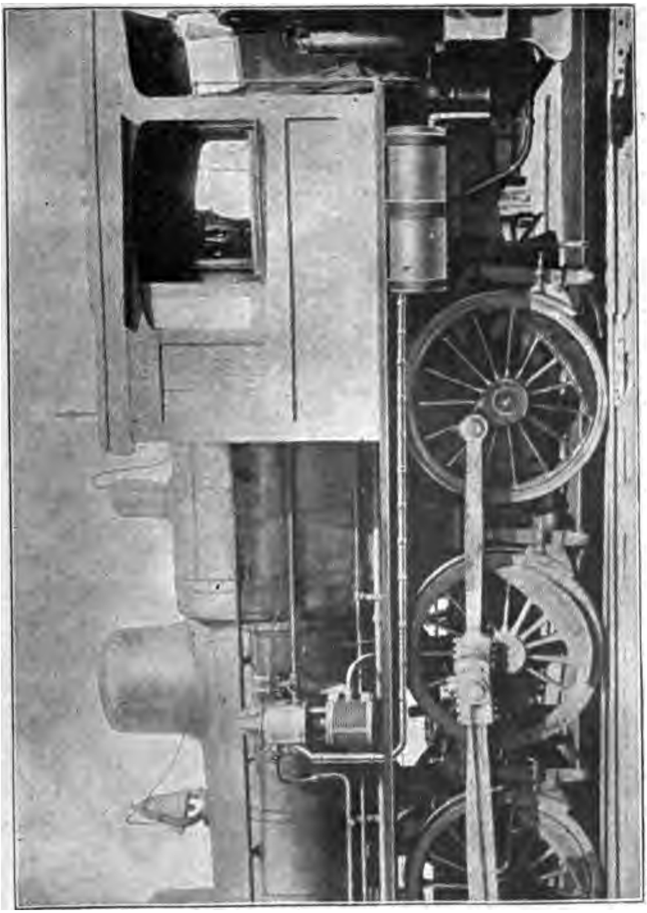


FIG. 23. SHOWING LOCATION OF APPARATUS.

work satisfactorily *without change of spring* and the ease with which it can be adjusted for any desired change of working *steam pressure.*

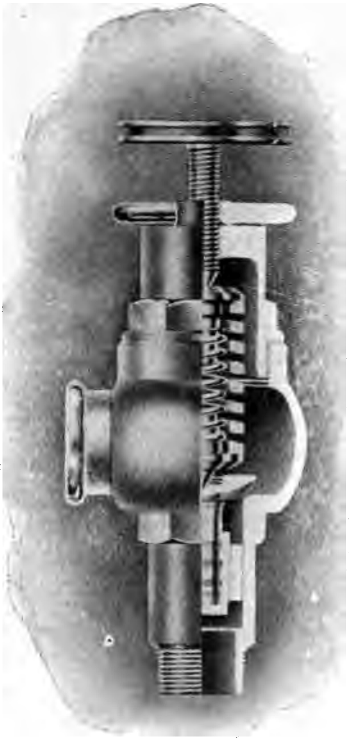


FIG. 24. "G. C. H." RELIEF VALVE.

It will give an *automatic* and *full relief* at any steam pressure between 15 and 60 pounds per square inch. This is accomplished by the *duplex spring,* the *outer spring* being *under tension* at *all pressures,* while the *inner spring* (of smaller diameter) is *under tension only* at the *higher pressures.*

The springs are adjusted for the valve to relieve at the desired pressure, by means of a hand wheel on the top, *outside* of the valve body. To obtain a higher working pressure, slacken the Cross Bar Check Nut and turn the hand wheel *from left* to *right*; for a lower working pressure turn the hand wheel from *right* to *left* and tighten the Cross Bar Check Nut.

Another important feature of the "E. C. H." Relief Valve is that it can be *taken apart* and *cleaned* if necessary *without* disconnecting the pipe connections at either the inlet or outlet.

The "E. C. H." Relief Valve is made entirely of high grade composition metal with springs of *Jessop's steel.*

GOLD'S STEAM HEATING APPARATUS.

As in other systems of heating the cars with steam from the locomotive, the equipment on the engine and tender is not complicated, but is, on the contrary, quite simple. All pipes should pitch to avoid water pockets and any exposed pipes should be covered well. Fig. 25 shows the method of taking steam at the fountain, by means of a locomotive starting valve, with a Tobin bronze spindle. This valve also has a hard metal seat and a malleable iron handle. The inlet is screwed into a 2-inch port in the fountain, and from this inlet runs a 1½-inch extra heavy pipe to the inlet of the regulator. The pressure regulator is provided with brass unions at both sides, the inlet being 1½ inches and the outlet 2 inches. A 2-inch nipple runs from the pressure regulator outlet to a tee which is tapped for ¼-inch pipe connection

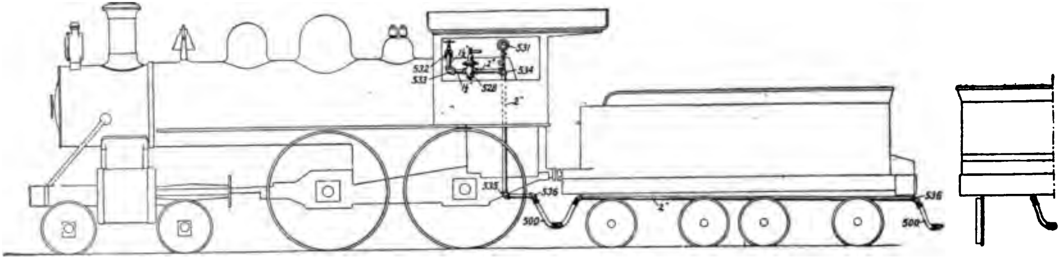


FIG. 25. GOLD'S HEATING APPARATUS, ITS APPLICATION TO LOCOMOTIVE.

532—Starting Valve.
528—Improved Pressure Regulator.
531—Steam Gauge.
500—Steam Coupler.
533—Ell, 1-½"
534—Tee 2"x¼"x2".
535—Ell, 2".
536—Ell, 2"x1½", 65°.
552—Coupling, 2", R. and L.

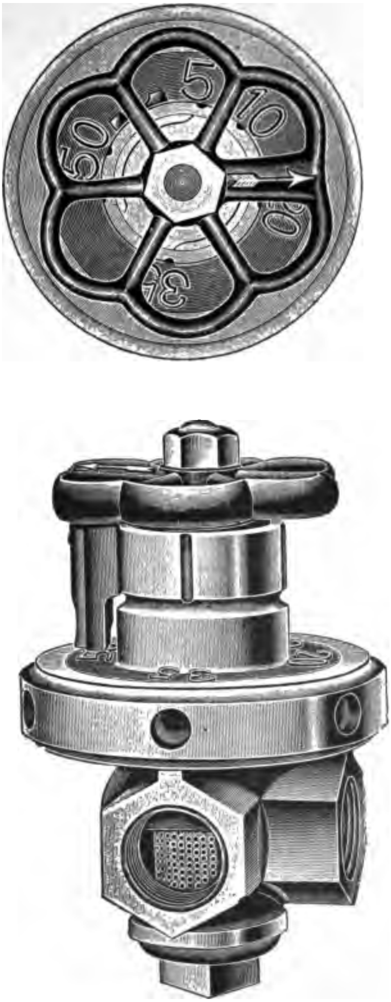


FIG. 26. IMPROVED TEMPERATURE REGULATOR.

to the steam gauge which indicates the steam pressure delivered to the train. The 2-inch line runs down to a suitable place at the side of the boiler and thence goes horizontally to a point where the 2-inch by 1½-inch sixty-five degree ell is situated. To this elbow a steam hose coupler is attached, and the nearby coupler is attached to the pipe under the tender by means of a similar ell. A 2-inch line runs to the back of the tender with a pitch to the rear and then a 2-inch by 1½-inch sixty-five degree ell is fitted and the steam coupler connected.

An improved temperature regulator and stop valve shown in Figures 26 and 27 reduces the steam pressure to that needed for heating and maintains whatever pressure is desired in the train-pipe regardless of varying conditions on each side of the valve.

Figure 27 shows a sectional view of the temperature regulator.

Steam from the train line enters at "R."

As the wheel "G" is turned from left to right, the spring "C" compresses, and its force, acting through the diaphragm, opens valve "L" and "M." Steam then passes to the radiator.

After the required pressure has been delivered, any increase will overcome the tension of spring "C," and as valves "L" and "M" are perfectly balanced, the lower spring "N" will immediately lift them to their seats, thus stopping the admission of steam.

As the pressure decreases in the regulator it also relaxes under the diaphragm, and the tension on the spring "C" again forces the valves "L" and "M" downward and holds them open until enough steam is admitted to compensate for the amount lost by radiation. When the required pressure is again delivered, the valves close automatically as before.

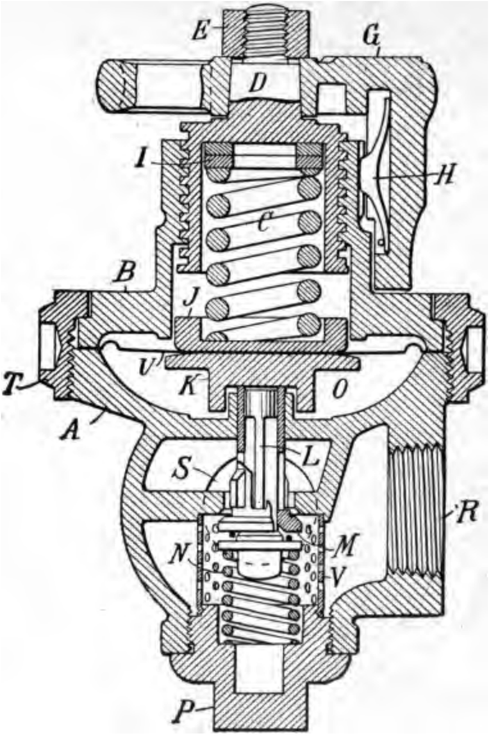


FIG. 27. SECTIONAL VIEW IMPROVED TEMPERATURE REGULATOR.

Parts of Gold's Improved Temperature Regulator.

A—Body of Regulator.
B—Dome of Regulator.
C—Top Spring.
D—Adjusting Screw.
E—Top Nut.
G—Wheel.
H—Indicator Spring.
I—Washer.
J—Top Flange.
K—Bottom Flange.
L—Auxiliary Valve Spindle.
M—Main Valve Spindle.
N—Bottom Spring.
P—Bottom Plug.
R—1-Inch Inlet.
S—1-Inch Outlet.
T—Spanner Nut.
U—Diaphragm.
V—Strainer.

If additional heat is needed, the pressure must be increased. To do this, wheel "G" should be turned further to the right. If a lower temperature be desired, the wheel should be moved in the reverse direction.

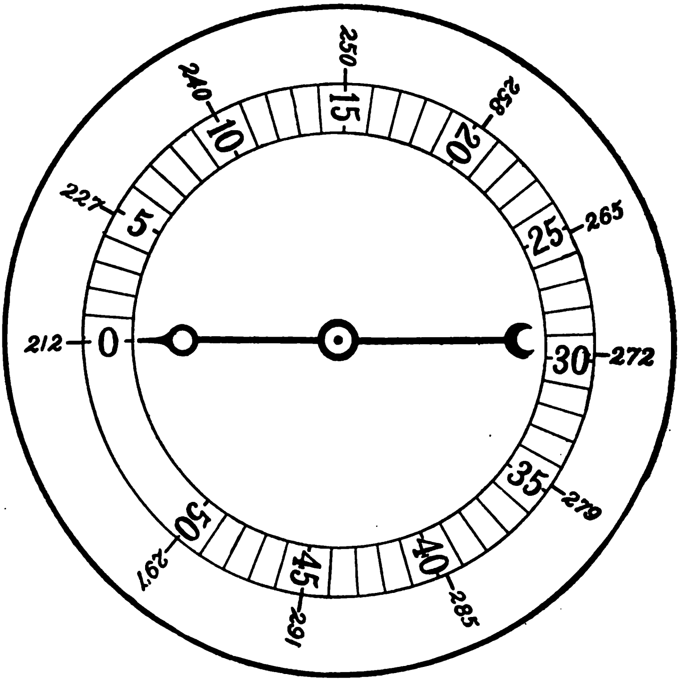


FIG. 28. PRESSURE RADIATOR DIAL.

The figures on the dial indicate pressure in radiator (see Figure 28). A number of grooves are provided in which the spring "H" may rest. These provide a friction lock. They are so arranged that the regulator will deliver 5—10—20—35 or 50 pounds. When wheel "G" is turned clear back to the stop, the valve will then supply only 2 pounds pressure.

Steam condenses in chamber "O" and this forms a water seal which prevents chattering.

The smaller valve "L" is the medium which affords a proper balance. When both valves are seated the spindle of "L" extends one thirty-second of an inch beyond that of "M." As the plate "K" travels downward, the valve "L" is opened first and passes steam to the low pressure side through the slotted openings in the spindle of valve "M."

This auxiliary valve is the medium which admits of a supply of a very limited quantity of steam when occasion demands.

Plate I shows the way the piping is laid out and also the regulator connections. It is explained as follows:

EXPLANATION OF PLATE V.

No. 752 is the cross fitting in the train-pipe, from either side of which branches lead into the cars.

The strainer nipple (750), is screwed into the cross, fitting in such a manner that it extends a short distance into the main line. The object is to so locate the end of this strainer that steam in passing back and forth will keep it perfectly clean.

The right and left coupling (550) is attached and a 1¼-inch pipe runs to the ell (542). From the upper side of this ell 1-inch pipe leads to the lock shield stop valve (753), which is connected to the temperature regulator by a close shoulder nipple.

The lock shield stop valve (753), which is provided with a strainer, is operated by a key (753a) and is to be

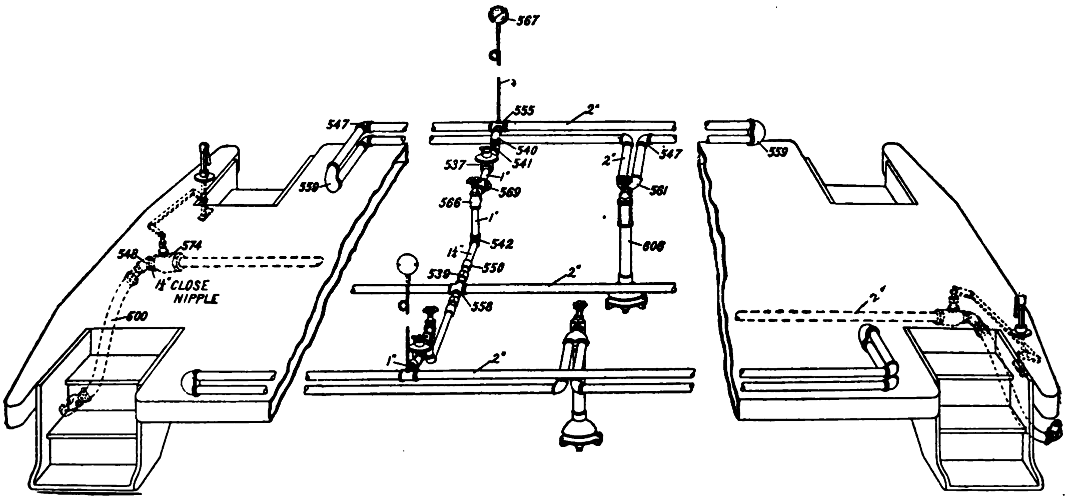


FIG. 29. GOLD'S IMPROVED DIRECT SYSTEM FOR HEATING PASSENGER CARS.

600—Gold Steam Coupler.
574—Gold End Train Pipe Valves.
537—Gold Temperature Regulator.
569—Strainer Tee.
567—Car Gauge.
590—Gold Improved Tee Trap.

566—1" Supply Valve.
555—2"x2"x1" Tee, ¼" Side Outlet.
559—2" R. and L. Return Bend.
547—2" R. and L. Ell.
560—2" Return Bend, 1½" Side Outlet.
545—1½" Ell.
539—Strainer Nipple.

558—2"x2"x1¼"x1¼" Cross.
518—1½" 65° Ells.
550—1¼" R. and L. Coupling.
542—1¼"x1" Ell.
540—1" Ell.
541—1" R. and L. Ell.

closed only when it is desired to shut all steam from the radiating pipes.

Gold's Direct Steam System—(Improved): A two-inch train line is located under the car, at the middle of it a cross (558) Figure 29, is placed, from which fitting branches lead to either side. There should be a pitch from the cross to the valves at either end. Each side of the car is controlled by a separate admission valve and temperature regulator. By referring to the illustration it will be seen that the heating surface consists of two courses of two-inch pipe along the truss-planks, expansion loops being provided as shown. The two-inch return bends (559) used for these loops are tapped to spread. The upper line has to be in line with the top of the truss-plank, so only the lower pipe pitches downward because of the special tapping. The lower radiator pipes run to loops which end in the special bends (560), and from the side of these bends a one and a half drip pipe is carried down through the floor to the automatic tee traps. All the pipes which lead to traps have to pitch downward so the water of condensation may always readily pass to th

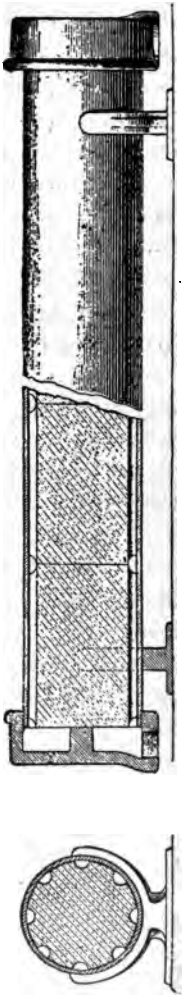


FIG. 30. CYLINDER CONTAINING BRICKS FOR STORING HEAT.

outlet; and particular care ought always to be taken to avoid water pockets.

Gold's Improved Storage System for Heating Compartment Cars: This is a system which, it is claimed, combines rapid and effective heating with great economy; the construction of the heater being based upon scientific principles and in accordance with the well-known laws of natural philosophy. The storage is provided for by Terra Cotta Sections, as shown in Figure 30 where they appear like bricks in a cylinder. The latter is usually a five-inch boiler tube and the bricks which fit snugly inside are twelve inches long, as many bricks being put inside the tube as are needed to fill the heater which is to be used. When steam is let in to the heater it passes through the corrugations of the bricks and circulates around them, thus the cylinder is immediately heated while the bricks absorb very readily the hot condensed steam. Thus the car is rapidly warmed and the heat is stored in the cylinder at the same time. The surplus condensation passes out at the opposite end of the heater, down through a drip pipe, and is discharged at a trap. The train pipe is under the car and has a gravity pitch to either end of it. Steam is taken from this train line and after it has passed through a strainer nipple, goes through a one-inch pipe to an angle valve, then through a strainer tee, and directly to the temperature regulator; this latter admits whatever quantity of steam is needed to the separate supply pipe, and from this pipe branches are run directly to the several heaters in the car. The storage heaters rest on stands and are slightly pitched from the inlet toward the outlet side, the object being to allow the surplus condensation to pass readily to the traps. The separate supply pipe

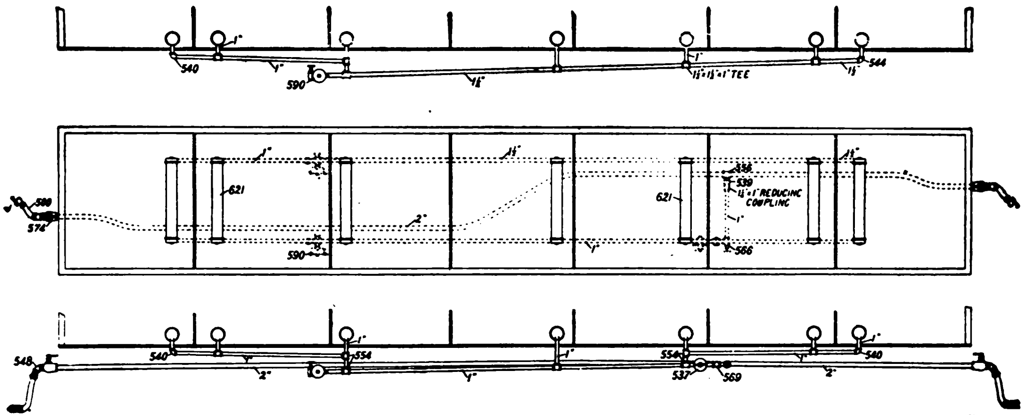


FIG. 31. GOLD'S IMPROVED STORAGE SYSTEM FOR HEATING COMPARTMENT CARS.

500—Steam Coupler.
574—End Train Pipe Valves.
537—Temperature Regulator.
569—Strainer Tee.
590—Improved Tee Trap.
566—Supply Valve, 1".
539—Strainer Nipple.
621—Storage Heater.

623—High Storage Heater Stand.
624—Low Storage Heater Stand.
552—Couplings, 2", R. and L.
548—Ells, 1½"x65°.
556—Tee, 2"x2"x1¼".
544—Ell, 1½"x1".
554—Tee, 1".
540—Ell, 1".

should pitch downward from the regulator to the trap, and the main condensation pipe should also pitch downward to the trap. The heaters are located under the seats, and owing to the large surface of radiation the temperature in the car can be very rapidly raised. The storage capacity of the terra cotta sections is so great that the heat is retained by them and is radiated from the cylinder for several hours after the steam has been shut off from the car. One heater is placed in each compartment, so the space is warmed very quickly indeed (see Figure 31). The amount of heat may be regulated according to the weather, the temperature regulator making it possible to have any desired pressure of steam and accordingly whatever amount of heat is desired.

Gold's Improved System of Hot Water Circulation: Two duplex coils are placed in a Baker or similar heater as shown in Figure 32a. The outer and inner pipes end in fittings specially designed for the purpose. As shown in Figure 32b the smaller pipe passes through the entire length of the larger pipe and extends a short distance beyond it. When the circulating pipes are filled, water occupies the space between the outside of the smaller pipe and the inside of the larger pipe. If fire is used the water is heated by direct contact of the outer pipe, but when steam is used it is heated by the inner pipe. Steam can be used independently of the fire or both may be used at the same time. The convenience of this arrangement is not only its adaptability, but likewise the ease with which cars may be piped for this system.

At the top of each of the coils are special fittings from which quarter inch pipes connect to the inlet of the sealed jet. (See Figure 33.) From the top of the jet to the expansion drum a short and heavy brass nipple is run.

From the bottom outflow, pipes run around the car and return to the coil as shown. Figure 33 shows how one port of this bend is carried through and inside the other and is slightly tapered at the end. The heated water goes up through the riser and enters the inlet of this sealed jet. It then moves around the bend, and owing to the taper of the nozzle and the energy behind, is forced downward into the outflow pipes with much velocity. Any air which is mingled with the water separates at the jet and passes up to the drum. The small hole near

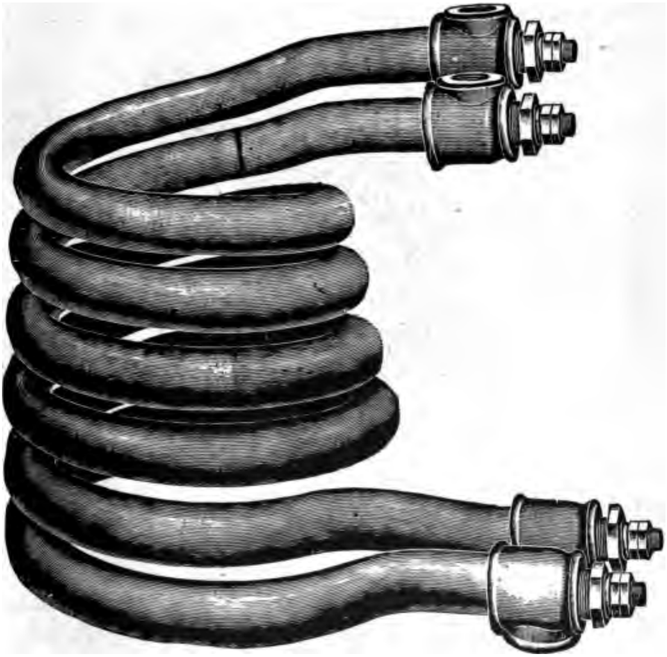


FIG 32A. DUPLEX COILS.

the top of the directing bend is there to release any air that might otherwise accumulate at that point when the pipes are being filled with water.

Steam is taken from the train-pipe through an inch and a quarter pipe to the inside of the car. From that point an inch pipe goes to the top of the heater where it is connected by two separate valves to the one inch coils.

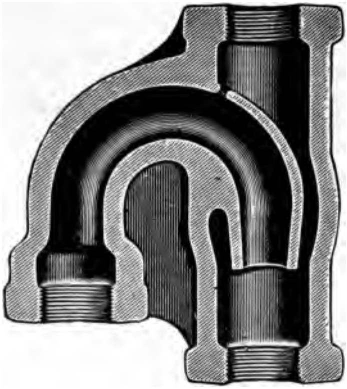
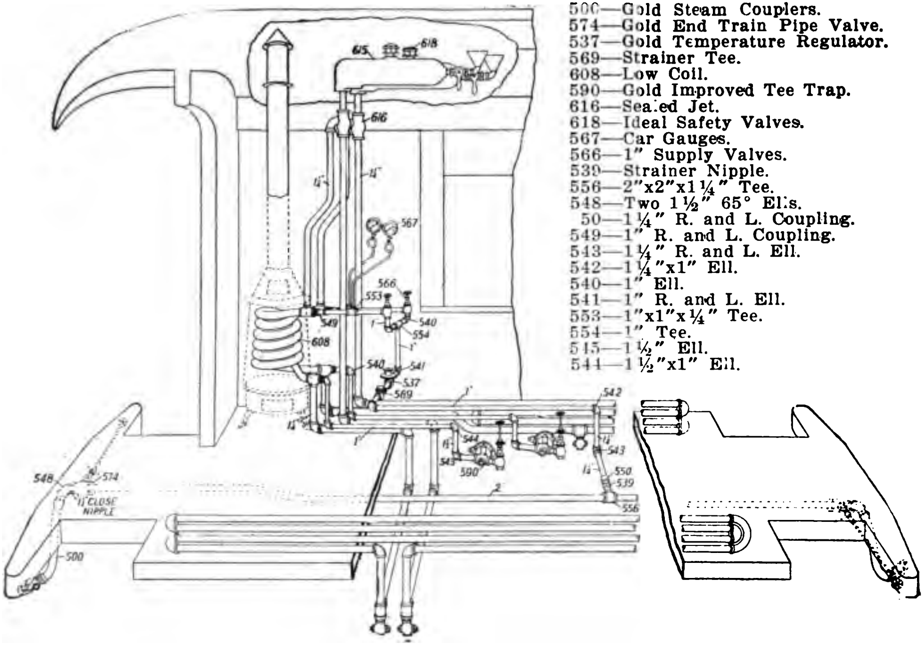


FIG. 32B. SECTIONAL VIEW DUPLEX COILS.

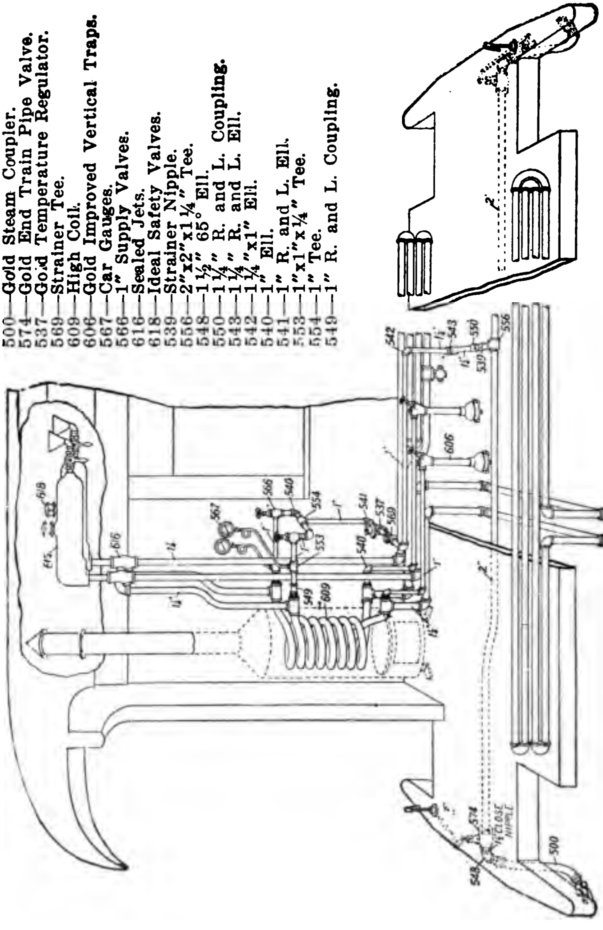
Through these inner coils the steam passes out at the bottom to drip pipes which run directly to the traps. Thus the two sides of the car are separate and may be controlled independently of each other. The temperature regulator is placed at a convenient point near the heater.

A system of hot water circulation with vertical traps is shown in Figure 34. It will be noticed that the plan of piping is the same as that shown in Figure 33 with the exceptions as follows: The vertical style is shown in place of the automatic tee trap, and instead of the end train pipe valve step attachment a platform operating mechanism is substituted.



500—Gold Steam Couplers.
574—Gold End Train Pipe Valve.
537—Gold Temperature Regulator.
569—Strainer Tee.
608—Low Coil.
590—Gold Improved Tee Trap.
616—Sealed Jet.
618—Ideal Safety Valves.
567—Car Gauges.
566—1" Supply Valves.
539—Strainer Nipple.
556—2"x2"x1¼" Tee.
548—Two 1½" 65° Ells.
50—1¼" R. and L. Coupling.
549—1" R. and L. Coupling.
543—1¼" R. and L. Ell.
542—1¼"x1" Ell.
540—1" Ell.
541—1" R. and L. Ell.
553—1"x1"x¼" Tee.
554—1" Tee.
545—1½" Ell.
544—1½"x1" Ell.

FIG. 33. GOLD'S IMPROVED SYSTEM OF HOT WATER CIRCULATION.



500—Gold Steam Coupler.
574—Gold End Train Pipe Valve.
537—Gold Temperature Regulator.
569—Strainer Tee.
609—High Coil.
606—Gold Improved Vertical Traps.
567—Car Gauges.
566—1" Supply Valves.
616—Sealed Jets.
618—Ideal Safety Valves.
539—Strainer Nipple.
556—2"x2"x1¼" Tee.
548—1½" 65° Ell.
550—1¼" R. and L. Coupling.
543—1¼" R. and L. Ell.
542—1¼"x1" Ell.
540—1" Ell.
541—1" R. and L. Ell.
553—1"x1"x¼" Tee.
554—1" Tee.
549—1" R. and L. Coupling.

FIG. 34. GOLD'S IMPROVED SYSTEM OF HOT WATER CIRCULATION.

COMBINATION AUTOMATIC LOCK AND HOSE SUPPORT (GOLD'S).

This device is designed to accomplish two purposes—the automatic locking of steam hose couplers and the proper support of the hose and coupler.

The advent of larger hose and heavier couplers necessary to heat the long passenger trains now in common use made the problem of tight joints and hose protection one of greater importance than ever before, and, taken in connection with the higher steam pressures carried in the train line to satisfactorily effect the heating of these long trains, the jarring on fast runs causes considerable leakage of steam, especially in passing around curves. In the new arrangement the hose is relieved of the weight of the couplers both when coupled and when separated, the couplers being supported by means of a chain attached to the platform and sill, and a connection between the chain and coupler is made by means of a lever or lock hinged onto the coupler attached to the same car and bearing on the mating coupler of the adjacent car in such a manner as to force the gaskets into close contact. This removes all the weight from the hose, and presses the gaskets together with a force much greater than that due to their weight and the action of the cam and wedge, which are still retained as integral parts of the coupler.

Figure 35 shows the device and Figure 36 shows it attached to a car.

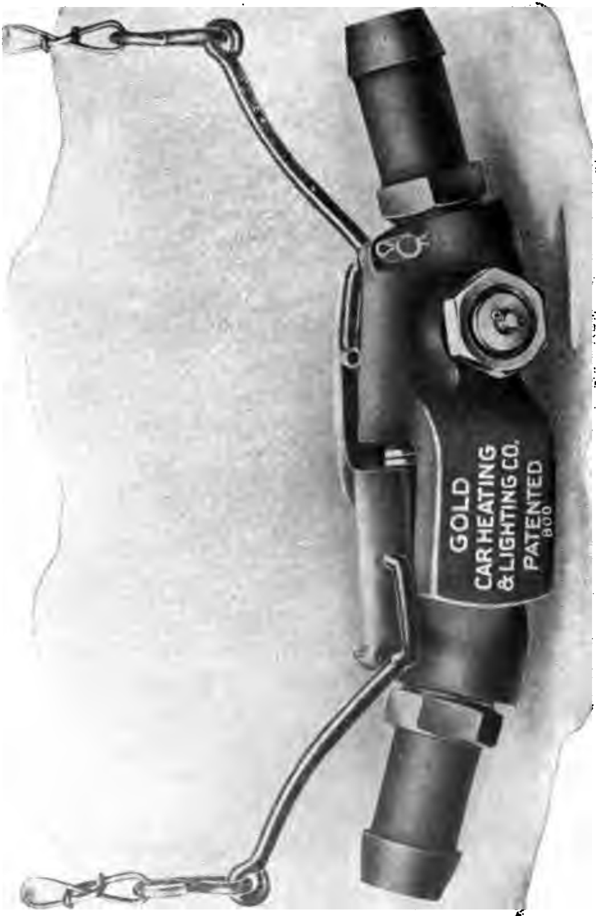


FIG. 35. COMBINATION AUTOMATIC LOCK AND HOSE SUPPORT.

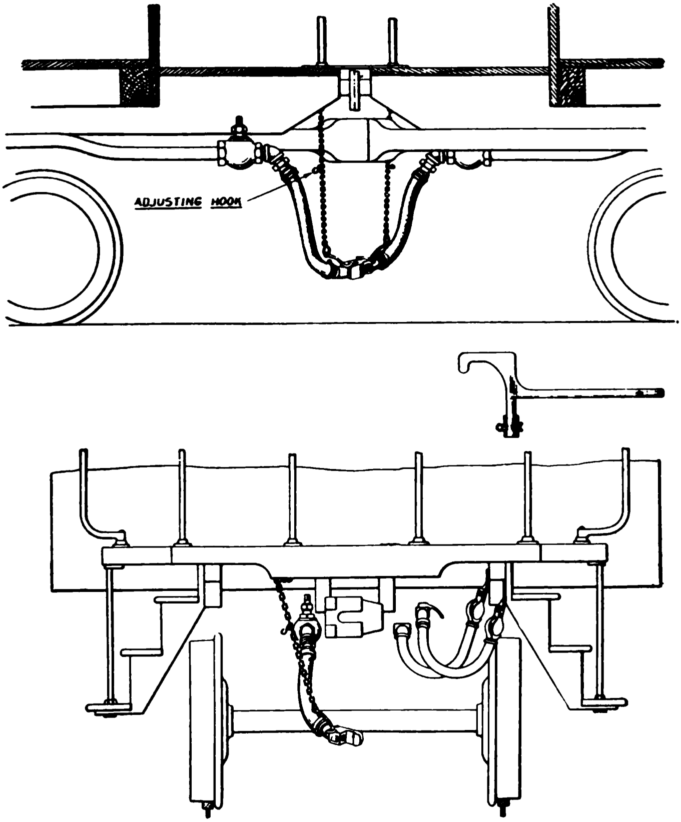


FIG. 36. COMBINATION AUTOMATIC LOCK AND HOSE SUPPORT ATTACHED TO A CAR.

VAPOR SYSTEM OF CAR HEATING.

This is a system of car heating which is manufactured by the Chicago Car Heating Co. It is an exceedingly simple apparatus, and the principle upon which the system operates is equally simple.

The temperature of the escaping condensation from the heating pipes is used to operate and control in an automatic manner the inflow of the steam from the train pipe to the heating pipes which are inside the car, instead of its being used to control the outlet or discharge. Thus the entire heating pipes are left open to the atmosphere all the time and the condensation flows out by gravity immediately it reaches the lowest points of the heating pipes, and in consequence of the entire absence of water in the pipes through "backing up" the possibility of freezing is completely done away with. The pipes are automatically filled with steam at atmospheric pressure (which is equal to 212 degrees, or the same temperature as boiling water), thus a very agreeable heat is radiated.

The heat of the escaping condensation has, in other systems, been used to automatically operate some form of a trap or discharge valve located in the outlet or the lowest part of the heating pipes, which has resulted in carrying about the same pressure in the radiating pipes inside the cars as was carried in the train pipe located underneath the cars.

In the vapor system train pipe pressure only reaches the inlet of the radiating system, as shown in the comparison of systems in Plate VI, but in the case of the steam pressure system train pipe pressure goes through the entire radiating system to the outlet. This method of carrying train pipe pressure in the heating pipes inside the car has frequently resulted in the cars being over-heated, because of the high train pipe pressure necessary. The trap or valve which has been placed at the outlet has, it is claimed, caused more or less backing

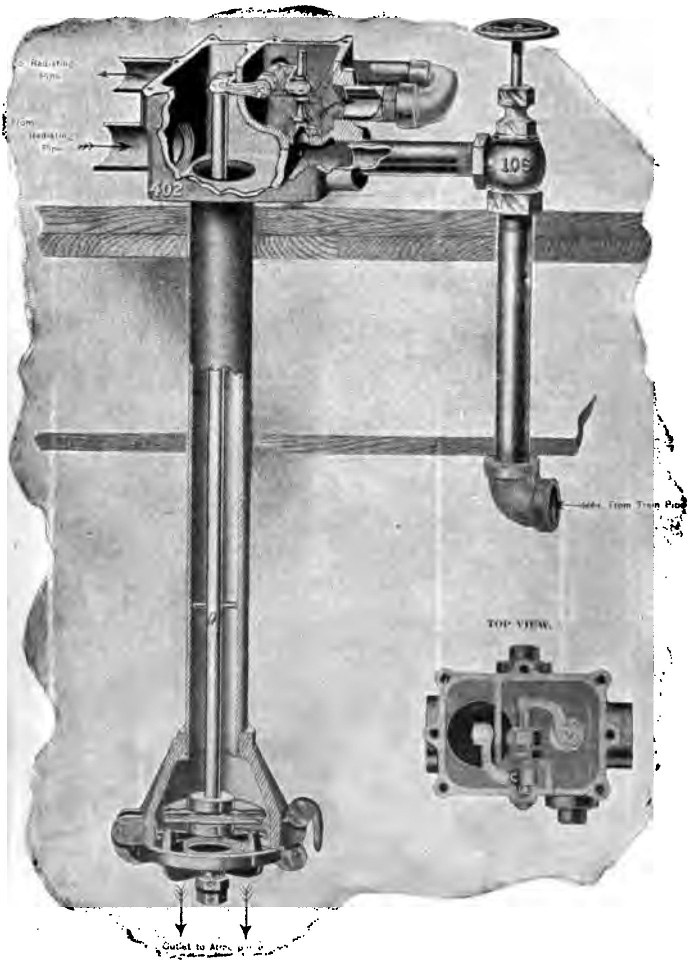


FIG. 37. VAPOR HEATING—SECTIONAL VIEW.

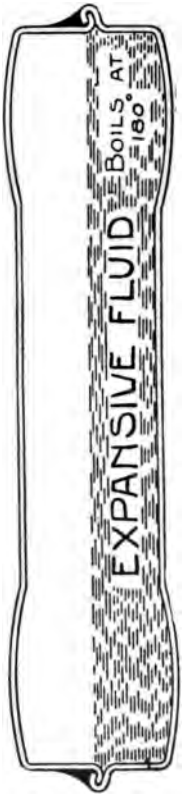


FIG. 38. EXPANSIVE DIAPHRAGM.

up of water in the pipes, and this has often resulted in the apparatus being frozen.

Figure 37 shows a sectional view of the piping arrangement. The expansive diaphragm (see Figure 38) is combined with and adapted to other parts of the apparatus to control the admission of steam. It is placed at the very outlet of the apparatus underneath the car, where it is subject to the combined influence of the cold outside air and the hot condensation pressing over and around it before it reaches the atmosphere.

The steam entering the pipes passes through the hand operated admission valves in the usual way and into the Vapor Regulator, where it passes up through the automatic valve and out of the regulator again, then through the feed pipe to the radiating pipes along the truss plank, finally reaching the bottom of the regulator and passing down through the discharge pipe and around the expansive diaphragm and out to the atmosphere. Instantly the hot condensation and steam reach the diaphragm at the very bottom of the apparatus, it expands it about a quarter of an inch, causing it to push up the operating rod and close down the automatic valve, thus closing the supply of steam to the radiating pipes at the inlet of the Vapor Regulator. The instant the supply of steam to the radiating pipes is thus shut off, the diaphragm in the outlet of the apparatus starts to cool, and contracts just enough to permit sufficient steam to pass the automatic inlet valve to make up for whatever is lost in condensation in the radiating pipes and still maintain a temperature of 200 degrees at the outlet point underneath the car at which the diaphragm is located. Less than 200 degrees temperature around the diaphragm at the bottom causes it to contract and open the admission valve until sufficient steam is passing into the apparatus to give 200 degrees at the very outlet. A temperature of much over 200 degrees at the outlet expands the diaphragm and cuts down the admission of steam until the temperature at the outlet reaches 200 degrees. Therefore the temperature of the outlet of the apparatus (which contains the diaphragm, Figure 38) is automatically maintained at a temperature of about 200 degrees, and necessarily all the pipes between this outlet and the inlet are maintained at a temperature of between 200 degrees at the outlet point, and about 212 degrees at the inlet point.

DETAILS OF OPERATION.

The Vapor Regulator is divided by partitions into three parts (see Figure 39), a high pressure chamber directly under the automatic valve "A," a low pressure or supply chamber directly above the automatic valve, and an outlet chamber where the return or drain pipe from the heating pipes inside of the car is connected to the regulator.

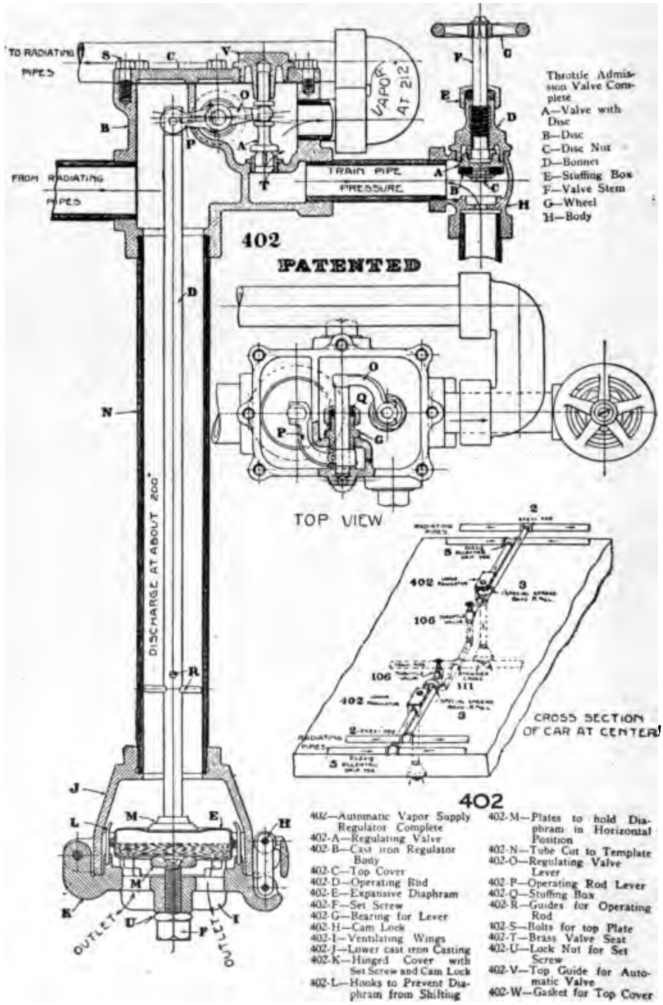

TO RADIATING PIPES
FROM RADIATING PIPES
S
C
V
B
O
P
A
T
VAPOR AT 212°
TRAIN PIPE PRESSURE
402
PATENTED
D
N
DISCHARGE AT ABOUT 200°
R
J
L
M
E
H
K
U
F
I
OUTLET
OUTLET
TOP VIEW
Q
G
CROSS SECTION OF CAR AT CENTER
2
3
5
106
111
RADIATING PIPES
Throttle Admission Valve Complete
A—Valve with Disc
B—Disc
C—Disc Nut
D—Bonnet
E—Stuffing Box
F—Valve Stem
G—Wheel
H—Body
402
402—Automatic Vapor Supply Regulator Complete
402-A—Regulating Valve
402-B—Cast iron Regulator Body
402-C—Top Cover
402-D—Operating Rod
402-E—Expansive Diaphram
402-F—Set Screw
402-G—Bearing for Lever
402-H—Cam Lock
402-I—Ventilating Wings
402-J—Lower cast iron Casting
402-K—Hinged Cover with Set Screw and Cam Lock
402-L—Hooks to Prevent Diaphram from Shifting
402-M—Plates to hold Diaphram in Horizontal Position
402-N—Tube Cut to Template
402-O—Regulating Valve Lever
402-P—Operating Rod Lever
402-Q—Stuffing Box
402-R—Guides for Operating Rod
402-S—Bolts for top Plate
402-T—Brass Valve Seat
402-U—Lock Nut for Set Screw
402-V—Top Guide for Automatic Valve
402-W—Gasket for Top Cover

FIG. 39. DETAILS OF VAPOR REGULATOR.

Steam leaves the train pipe at the strainer cross (No. 111), and passes through the admission valve into the high pressure chamber. After passing through the automatically operated valve "A" into the low pressure chamber it passes out of the Vapor Regulator again, and through the feed pipes into the radiating pipes at the side of the truss pipe where it branches and flows to each end of the car, returning again to the center where it joins again in one pipe and flows through this pipe into the outlet chamber of the vapor regulator and down through the tube and around the expansive diaphragm and out to the atmosphere.

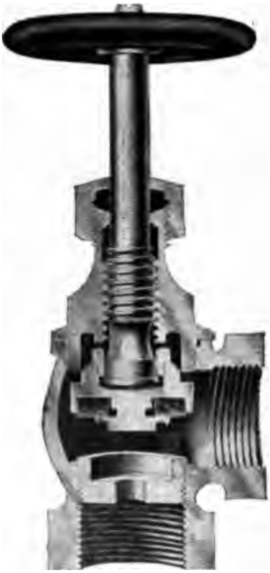


FIG. 39A.

As already explained, the heating of the diaphragm to about 200 degrees at the outlet causes the closing of the automatic valve "A" sufficiently to pass just enough steam into the radiating pipes to circulate entirely through them and maintain a temperature of 200 degrees at the outlet point, and it should be remembered that if the temperature around this outlet drops below 200 degrees the diaphragm will contract instantly just enough to open the automatic valve "A" to permit sufficient steam to pass into the apparatus to *raise the temperature at the outlet to 200 degrees.*

Until the steam passes the automatic valve "A" it is, of course, under train pipe pressure, but after it passes the valve "A" it is under atmospheric pressure, and in just sufficient quantity to pass entirely through the pipes and give the required 200 degrees at the outlet.

It is found that this automatically maintained temperature of 200 degrees at the outlet point underneath the car gives an actual temperature of about 208 degrees in the bottom or coolest pipes inside the car and 212 degrees in the top of the pipes where the steam first enters, and a temperature of 213 degrees immediately after the steam leaves the automatic valve, and these temperatures are found to *remain the same* regardless of what pressure or temperature the steam may be when it enters the Vapor Regulator from the train pipe.

This condition of affairs continues indefinitely as long as steam is on the apparatus.

As the radiating pipes are open to the atmosphere it will be readily understood that their temperature can never exceed 212 degrees at the hottest point.

Inasmuch as at no time is there any pressure backed in the radiating pipes, and as the outlet point is auto-

matically maintained at a normal temperature of 200 degrees, necessarily the discharge at the outlet must be nothing but actual condensation which will do no injury to varnish or sheathing. This overcomes a serious defect in steam traps which always discharge condensation under a pressure—resulting in scorching the side of car.

The passage for the discharge of condensation from the pipes to the atmosphere contains no trap valve or stoppage of any kind, and condensation is free to escape by gravity from the pipes to the atmosphere, as will be seen from the cut.

Motion from the diaphragm at the outlet, to the automatic valve "A" at the inlet, is transmitted through the dividing partition by means of the lever "P" passing through the stuffing box "Q."

As the pressure is inappreciable on either side of this stuffing box, and as the motion of the axis of the operating lever amounts to almost nothing, it will be evident that the wear of this packing is practically nothing and need not be considered as a feature needing attention after the device is in service. When valve 4 is a quarter of an inch, the weight of the rod D will keep the valve A open when the diaphragm is cold. To remove the automatic valve unscrew the brass guide cap V, open the hinge cover K at the bottom, allowing the rod D to drop down, then the automatic valve A can be easily lifted out. To get at the entire inside of the top part of vapor regulator, remove the brass stud bolts S, allowing the top plate to be removed.

The Expansive Diaphragm.—Figure 38, already referred to, is round, being about four inches in diameter and three-quarters of an inch thick, is made of phosphor bronze, and is filled about half full of a mixture of which alcohol forms the greater part, and it is hermetically sealed.

This mixture boils at a temperature of about 180 degrees, and when confined in the diaphragm and subjected to a surrounding temperature of between 200 and 212 degrees, a sufficient internal pressure is created to cause the diaphragm to expand about three-eighths of an inch and when the diaphragm is placed in the device and adjusted with the set screw so that the maximum movement cannot exceed a quarter of an inch, it will exert sufficient force to close a three-quarter inch valve seat against a pressure of as high as a hundred and twenty pounds to the square inch.

As the temperature surrounding the diaphragm falls, it begins to contract until at 180 degrees it is again at its original or normal thickness of three-fourths of an inch.

Plate VII shows the Vapor System applied to a standard passenger coach. The details of the Vapor Regulator are shown in the sectional view, Figure 39.

HEATING CARS WITH ELECTRICITY.

FIRST PRINCIPLES.

The conversion of electrical energy to heat takes place in accordance with well known laws, and in known proportions. One British Thermal Unit of heat is equivalent to 1047.3 watts, and cannot be produced without the expenditure of that amount of energy. A resistance coil which will pass a certain amount of current may be made of a short length of wire of high resistance, or of a long wire of low resistance. If the resistances of the coils are equal, the same amount of current will flow through each, and each coil will give off the same amount of heat. Consequently a short coil of high-resistance wire having a small surface must necessarily operate at an excessively high temperature, in order to dissipate the same amount of heat as the longer coil of low-resistance wire having a much larger surface. In this principle lies the success of the Consolidated Electric Heaters, which have a large heating surface and operate at a moderate temperature.

It is claimed by the manufacturers that experience has demonstrated that galvanized iron wire, which has been specially galvanized for the purpose, makes the best resistance coils, and that by reason of the large radiating surface made possible by the McElroy spiral coil construction, the wire is heated only to a moderate degree, thus the excessive temperature to which a high resistance wire is necessarily subjected, usually resulting in crystallization of the wire if accompanied by vibration, is overcome.

In each heater there are two resistance coils placed, one above the other. The upper coil is of greater resistance and consumes less current than the lower. The coverings of lead wires to the two coils are different colors, and thus may be easily distinguished. The top coils of all the heaters in the car are in series, and the bottom coils of all the heaters are in series. Thus, wherever current is used, heat is given out the full length of the casing of every heater in the car. At the same time this method of wiring is said to be the simplest and most economical in time of equipping and material used. All this type of heaters are said to secure convenience, simplicity and durability.

A coil for heater, showing resistance coil, porcelain bushings, end plates and lead fires is shown in Figure 40.

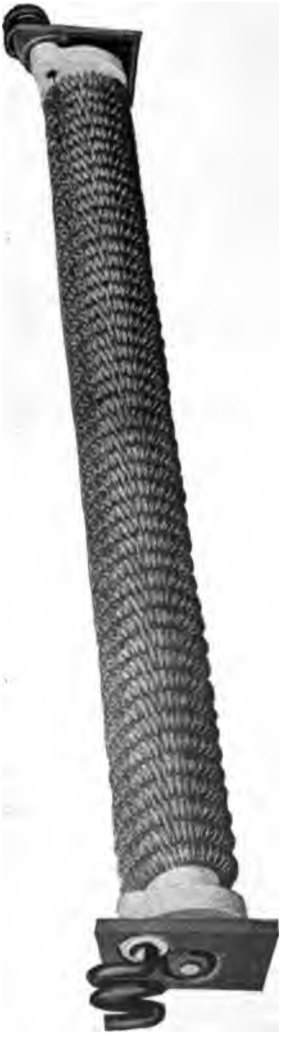


FIG. 40. COMPLETED COIL FOR NO. 143LL HEATER SHOWING RESISTANCE COIL, PORCELAIN BUSHINGS, END PLATES AND LEAD WIRES.

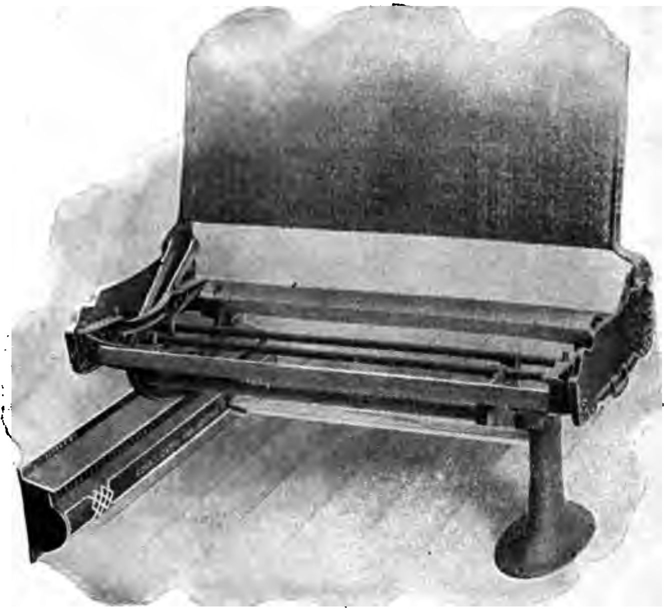


FIG. 41A. ELECTRIC HEATER IN POSITION.

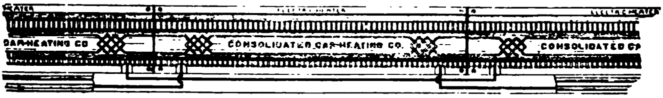


FIG. 41B. HEATER ENCLOSED IN INSULATED IRON CASING; WIRING SHOWN IN MOULDING.

A heater for a cross-seat car or parlor car is shown in Figure 41. It is designed to attach to the truss plank, and is designed to occupy about the same space as the steam pipes do when the steam heating system is employed. The coils are, it will be noticed, covered by an iron case of attractive design, which is insulated.

The arrangement for wiring when electricity is employed for heating cars is shown by the diagrams in Figure 42.

The coupler shown in Figure 43 is used for the purpose of connecting the heat and light circuits in trains.

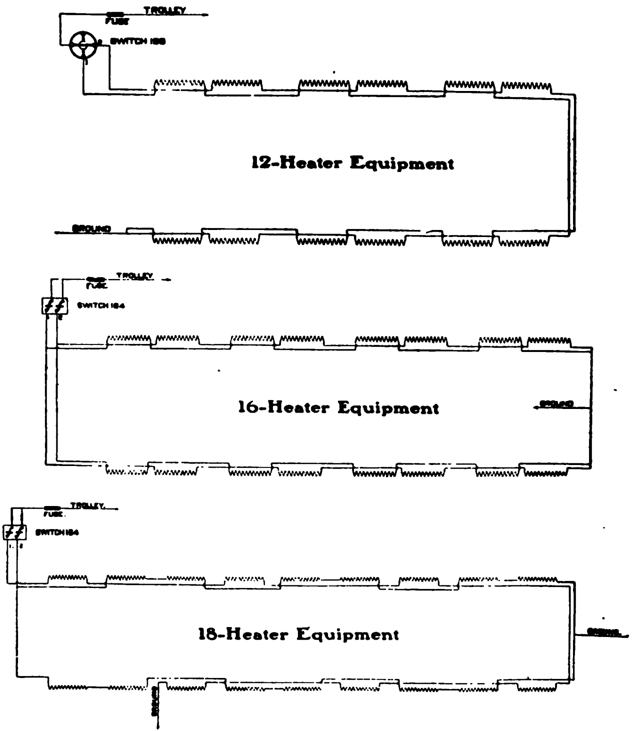
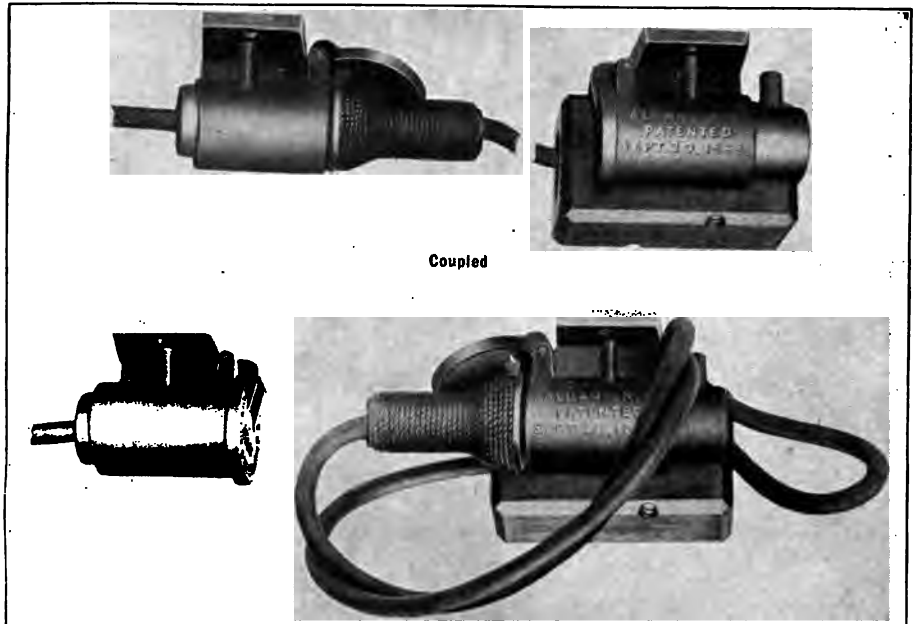


FIG. 42. DIAGRAMS OF WIRING ELECTRIC HEATING SYSTEM.

With this coupler there are no exposed contacts. The contact finger is mounted on the inside of a protecting casing which is attached at the end of the car, either



Coupled

Uncoupled

FIG. 43. ELECTRIC COUPLERS USED FOR HEATING TRAINS BY ELECTRICITY.

under the platform sill or under the hood, and the opening to this casing is covered with a spring door.

On the end of the flexible cable is securely attached a hollow cylindrical contact piece which slides over the contact finger mounted in the protecting casing on the opposite car. This cylindrical contact piece is mounted securely in an insulating handle which covers it not only on the sides, but projects beyond the end of the contact piece leaving no portion of the contact piece unprotected. No danger of short circuit occurs either in handling it or in allowing the connector to drop to the rail, since the cylindrical contactor is not exposed at the ends. When the contacts are once made the action of the door is to hold the contactor securely in place. In case the cars should pull apart the connector pulls out of the socket automatically.

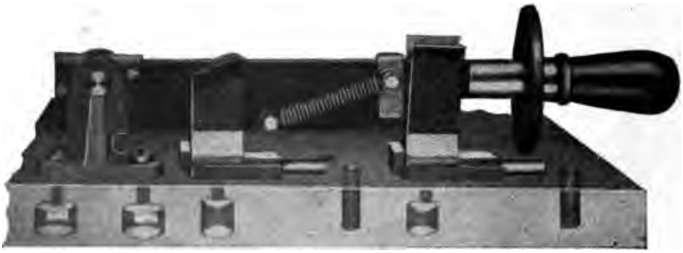


FIG. 44. A QUICK-BREAK KNIFE SWITCH.

A quick-break knife switch is illustrated in Figure 44. It has double contacts, and is intended for service on 600-volt circuits. Slate bases free from metallic veins are used to mount the switches upon, and as the slates are drilled to a templet and counter-sunk all current carrying parts are brought below the surface on the back of the slate. It is considered by the manufacturers advisable that all switches used for heating or lighting purposes should be placed on the bulkhead above the windows, either in the vestibule or the car body.

CATECHISM OF STEAM HEATING.

ON TRAINS EQUIPPED WITH THE STEAM HEATING SYSTEM. OF THE SAFETY CAR HEATING AND LIGHTING COMPANY.

DIRECTIONS FOR THE MANAGEMENT OF STEAM HEATING ON TRAINS.

MAKING UP TRAINS.

When a train is made up all steam hose should be coupled and all cocks or valves in the steam train pipe, the whole length of the train, should be opened.

When signal is given steam should be turned on at the cab and allowed to blow through the entire length of the steam train pipe.

After steam issues from the rear end of the train pipe, the rear train pipe valve of the last car should be closed. This valve is slotted and will allow a little steam to escape through the rear coupling.

REGULATION OF TEMPERATURE.

To heat cars, open steam inlet valve in each car and regulate the temperature with this valve. Do not ask the engineer to vary the steam pressure for the purpose of regulating the temperature of cars.

Steam inlet valves must not be shut tight in freezing *weather.*

Traps should be set at terminal points so that a little steam will escape with the water. Readjustment is seldom necessary.

CHANGING ENGINES.

Five minutes before arriving at terminals or stations where engines are to be changed, the rear train pipe valve must be opened wide, and just before coming to a stop at such stations the engineer should shut off steam at locomotive valve. Do not use reducing valve for this purpose. This valve is to be set at 40 pounds when the engine is placed in service and not changed thereafter, except in zero weather, when 5 pounds should be added for each additional car over eight.

Trainmen should see that steam is shut off at engine before uncoupling hose.

When cars are to be laid up all valves must be left open.

CATECHISM OF STEAM HEATING APPARATUS ON TRAINS.

I. DESCRIPTION OF THE APPARATUS.

Question. What is the advantage of using steam heat on trains?

1. Answer. Safety to trains as well as passengers by replacing the heat of the fire with the heat of steam, and for economy of operation.

Ques. How are cars heated by steam?

2. Ans. Either by direct steam, that is the admission of steam to radiating pipes in car, or on cars with Baker heaters, by means of steam jackets applied to the water circulation pipes.

Ques. How should the jackets be applied?

3. Ans. They should be located at nearly equal distances apart in the water circulating pipes, and to secure rapidity of circulation should have an upward slant of two or more inches in the direction the water flows.

Ques. How do the jackets operate?

4. Ans. As the circulating water passes through the jackets, it is heated by the steam. The water does not come in direct contact with the steam.

Ques. How is steam conducted to the jackets?

5. Ans. By a branch pipe from train pipe, leading through inlet valve to ends of jackets in series.

Ques. How many heating jackets are used on a car?

6. Ans. Ordinarily two or three with single coil heaters and twice the number with double coil heaters.

Ques. In what direction does the water flow when using steam?

7. Ans. In the same direction as when using a fire in the heater.

Where are the following parts located (a), and what are their functions (b)?

Ques. Locomotive valve?

8. Ans. (a) At the steam box in cab or other source of dry steam supply.

9. Ans. (b) To control the supply of steam to train pipe.

Ques. Reducing Valve?

10. Ans. (a) In cab.

11. Ans. (b) To control the pressure of steam in the train pipe.

Ques. Train pipe?

12. Ans. (a) Underneath tender and cars.

13. Ans. (b) To conduct steam to the cars.

Ques. How should the train pipe be applied?

14. Ans. So as to drain to each end of car, thereby avoiding pockets for the collection of condensation water, the prescribed measurements being closely followed in locating the ends of train pipes, in order to prevent the couplers from opening on curves.

Ques. Steam couplers?

15. Ans. (a) At ends of train pipe.

16. Ans. (b) To connect train pipes between cars.

Ques. Steam coupler safety chain?

17. Ans. (a) Under platform buffer timber; in accordance with standard measurements.

18. Ans. (b) To prevent the steam coupler from being *injured.*

Ques. Train pipe valve?

19. Ans. (a) At ends of train pipes, in accordance with standard measurements.

20. Ans. (b) To close rear end of train pipe, and to control same without disturbing passengers, also for protection in handling steam couplers.

Ques. Inlet regulating valve?

21. Ans. (a) Inside of cars—usually at heater room with cars having a Baker heater, and at inlet of radiators of cars having direct steam.

22. Ans. (b) To supply steam to heating jackets or direct steam pipes and to regulate the temperature in car.

Ques. Steam traps?

23. Ans. (a) Horizontal Trap No. 833 is underneath car at the lowest point in the steam transfer pipe, and should have a drain of two inches.

24. Ans. (a1) Vertical Trap No. 933 (used with direct steam only), at the lowest point in the steam radiators, extending through the car flooring.

25. Ans. (b) To automatically discharge the condensation water from the heating jackets or direct steam heating pipes.

Ques. Trap blow-off valve?

26. Ans. (a) At the inlet end of trap.

27. Ans. (b) To discharge the accumulation of dirt and scale from the trap.

Ques. Trap adjustment?

28. Ans. (a) At the low end of trap.

29. Ans. (b) For setting so as to allow a little steam or vapor to escape with the condensation water.

Ques. When should the trap be set?

30. Ans. When cars are tested with steam previous to being placed in service.

Ques. Why?

31. Ans. So that it will not be necessary to adjust the trap on the road.

Ques. How should the trap be set?

32. Ans. First open the adjustment wide; then after all pipes have become hot close it down until a little vapor escapes with the water of condensation.

Ques. What causes the trap to operate automatically?

33. Ans. The difference in expansion between the brass tube and the iron shell enclosing it.

II. OPERATION OF THE APPARATUS.

Ques. When should the reducing valve in cab be set?

34. Ans. When the engine is placed in service.

Ques. At what pressure should the reducing valve be set?

35. Ans. Forty pounds.

Ques. Under what conditions should the pressure on reducing valve be increased?

36. Ans. When there are more than eight cars, adding 5 pounds for each additional car in zero weather.

Ques. Should the reducing valve on engine be closed?

37. Ans. It should never be used as a shut-off valve.

Ques. What valve should control the supply of steam to train pipe?

38. Ans. The locomotive valve.

Ques. When should the locomotive valve be closed?

39. Ans. Five minutes before arriving at points where engines are to be changed, or terminals wher

train is to lay up and always before hose are uncoupled.

Ques. Should the locomotive valve be closed under any other condition?

40. Ans. Never while heat is required in the cars, except in cases of emergency.

Ques. Why?

41. Ans. To prevent condensation water in train pipe from freezing.

Ques. When should steam be admitted to train pipe?

42. Ans. After all steam hose are coupled and all inlet and train pipe valves are open, signal the engineer to open locomotive valve.

Ques. What is the next move?

43. Ans. Close end train pipe valve on rear car after train pipe is thoroughly blown out.

Ques. How is the end train valve operated?

44. Ans. By the extension handle operated at step side, or through an opening in step riser, thereby preventing the passengers from tampering with same from inside of vestibule.

Ques. When should the condensation water be blown out of the train pipe?

45. Ans. When the train is made up, also on approaching and before leaving points where engines are changed or the train laid up, and occasionally on the road, the rear valve only being used for this purpose.

Ques. When should traps be adjusted?

46. Ans. Traps should be inspected often to see if a little steam or vapor is being discharged with the water of condensation and reported at terminals if not *working properly*. Only adjust traps on the road when *bsolutely necessary.*

Ques. Why should a little steam issue from the rear train pipe valve on the road?

47. Ans. To prevent the accumulation of condensation water and to have live steam throughout the entire length of the train pipe in order to avoid freezing.

Ques. What temperature should be maintained in cars?

48. Ans. About 70 degrees Fahrenheit, with proper ventilation.

Ques. How should this temperature be regulated?

49. Ans. By adjusting the inlet valve.

Ques. When the steam supply is cut off from cars having Baker heaters, what should be done?

50. Ans. Start a fire in the heater.

III. CARE OF THE APPARATUS.

What test or inspection should be given the parts following?

Ques. Reducing valve?

51. Ans. It should be taken apart and thoroughly cleaned, oiled and tested before the steam heat season opens.

Ques. Gauge?

52. Ans. Should be tested with test gauge before season opens and occasionally in service.

Ques. Valves?

53. Ans. Before season opens, all valves and seats should be repaired, or renewed if necessary, and all valve stems repacked.

Ques. Traps (horizontal No. 833, vertical No. 933)?

54. Ans. Remove adjustment from low end valve from high end of trap, allowing steam to blow through until thoroughly cleaned, and renew Jenkins discs if necessary.

Ques. Steam couplers?

55. Ans. These should be removed from cars at the end of the season and stored at the shop after being repaired and tested and made ready for the next season. Cap or plug the opening in the end train pipe valve.

Ques. What is the proper method of filling heater pipes with water?

56. Ans. At the beginning of the steam heat season, open all draw-off cocks on water circulating pipe. After water is drained, blow steam through water circulating pipes, making attachment at draw-off cocks nearest heater. When pipes are clean, shut off steam, close draw-off cocks, remove safety valve in circulating drum and run a half-inch pipe thence to a coil in a barrel of water.

Then turn on steam again and boil water in barrel. After this, disconnect steam and close draw-off cocks and the water in barrel will syphon into and fill circulating pipes. After standing some time, the water, having cooled, will contract to some extent and a small amount of water may then be poured in through the combination cock. Then turn on steam at inlet valve and if water circulates quickly the pipes are properly filled. If water does not circulate properly, let water out of pipes and repeat operation.

Ques. How often should inspections be made to ascertain that water is at the proper height in circulating drums?

57. Ans. During the heating season they should be examined when cars reach terminals or yards.

Ques. Should Baker heater pipes be kept filled with water during summer?

58. Ans. Yes, as they will not rust so rapidly as when empty.

IV. RESPONSIBILITY OF EMPLOYES.

What are the duties for which the following employes are held responsible?

Ques. The repair shop employes?

59. Ans. For the proper application of and for the thorough overhauling and testing of the heating apparatus when cars are in shop.

Ques. The engineer?

60. Ans. For turning steam on or off at the locomotive valve when the prescribed signals are given, and for supplying the proper amount of steam for heating the train.

Ques. The conductor?

61. Ans. For knowing the pressure of steam supplied to the train and seeing that the proper temperature and ventilation is maintained and knowing that the other members of the crew are familiar with the operation of the steam heating apparatus.

Ques. The brakeman or flagman?

62. Ans. For blowing the condensation water out of the train pipe before arriving at terminals or stations where engines are to be changed, also at stations where there are no car inspectors, and for leaving all valves open when cars are to be laid up.

Ques. The round house inspector?

63. Ans. For the condition of the steam heating

equipment on the engine before it leaves the round house, and knowing that an extra steam coupler is carried.

Ques. The car inspector?

64. Ans. For the condition of the car heating apparatus and for blowing the condensation water out of train pipe before trains leave terminals and stations; for knowing that an extra steam coupler is carried on train and for having a supply of steam couplers and gaskets on hand.

LIGHTING PASSENGER CARS.

The Pintsch Gas Lighting System. The general arrangement of this system of lighting is shown in Figure 45, which also shows the general relation of the parts. "A" represents the storage tank, in which a sufficient supply of gas is carried to maintain the lights in the car the desired length of time, the number and size of the tanks varying in proportion to the requirements of the service. The gas is supplied to these tanks under pressure at regular filling stations, a hose connection being made between the supply pipe and the filling valve "B," which in turn are connected with the storage tank by means of the extra heavy pipe "D" connecting into the tank valve "C." The pressure in the tank is at all times indicated on the gauge "P." From a branch in pipe "D" the gas is conducted through the reducing valve or regulator "R," in which the pressure is so reduced and governed as to maintain a constant pressure of one-third of an ounce on the outlet pipe "F," irrespective of the pressure in the tank. The regulator controls the gas pressure on the lamps in a perfectly uniform and automatic manner, whether the pressure in the tank is two pounds or one hundred and fifty pounds. From the regulator the gas passes into the car at any convenient point and terminates in a main pipe "H" extending along and on the roof of the car, from which branches "I" are taken off at each lamp, connection being made to one of the arms of the lamp, designated as the gas-way arm, which contains a tube through which the gas passes down into the burner of the lamp "L." The gas is turned off and on by means of a gas cock "K" on the gas-arm of each lamp, but if desired all of the lamps can be regulated at once by means of the maincock "G" placed in the pipe "F" shown on the wall, or the gas can be shut off entirely at this same point. "O" represents a bracket lamp for use in toilet rooms and passage ways. "M" is a vestibule lamp used for lighting the platform and vestibule of a car.

The arrangement of the gas holder (or holders), the regulator, piping for gas under pressure, filling valves, etc., is shown in Figures 46, 47, 48 and 49. The way the connections are made for an equipment as shown in Figure 45 is shown in Figures 46, 47 and 48 as indicated by the full or solid lines. The method of connecting a second holder on that side of the car is likewise shown as indicated by the broken lines in Figure 46. Two holders, one on each side, are shown in Figure 49 as indicated by the full lines, and a third holder on one side is shown also, as indicated by the broken lines.

These holders are usually hung about one inch from the sheathing, as far as possible away from the sides of the car, the inlet connection end being away from the nearest truck, and the flat side of the angle iron upwards. Figures 48 and 49 show forms of the hanging irons, and another form is shown in Figure 50. The holder valve (53b), Figure 51, is attached to the holder by a flange (3) which is screwed on the holder inlet bushing, and a flange (3a) which is screwed on (53b) in a similar manner, the whole being secured *with screws* (150). The regular board is shown in

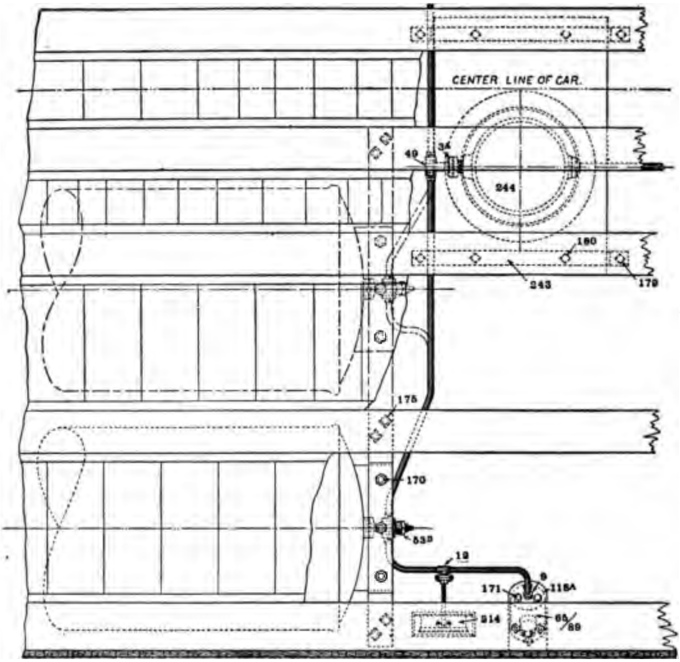

CENTER LINE OF CAR.
3A
65/89

FIG. 46.

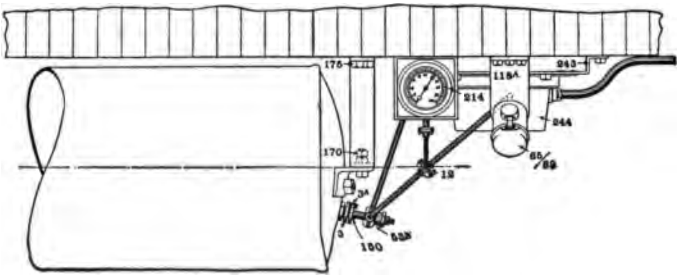

65/89
3A

FIG. 47.

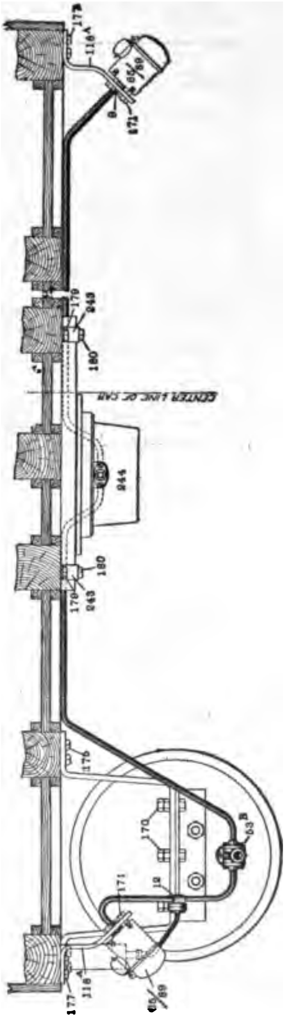

65/69
CENTER LINE OF CAR

FIG. 48.

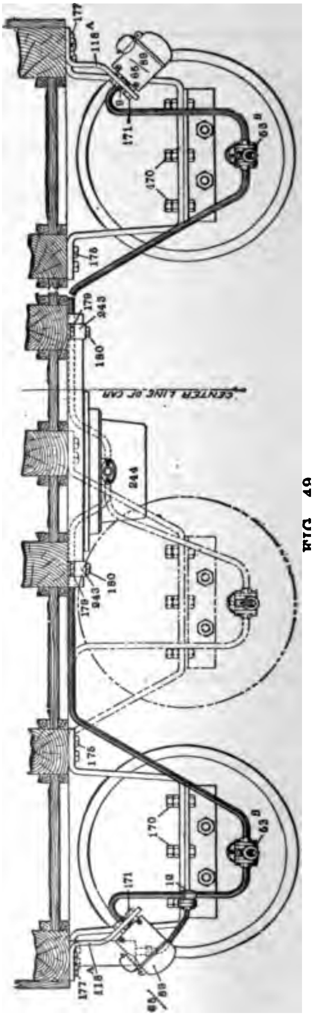

65/69
CENTER LINE OF CAR

FIG. 49

detail in Figure 52. The recess, in one face of this board, receives the upper part of the regulator cover. This board with the regulator attached is secured to the car body (see Figures 46, 48 and 49) by means of straps (243) and lags (180) passing through both the board and the straps and lags (179) passing through the straps only. Filling valve brackets (118a) are located

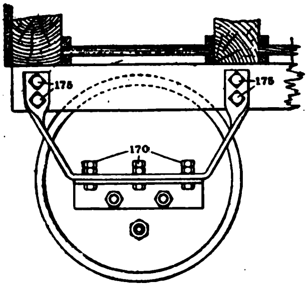
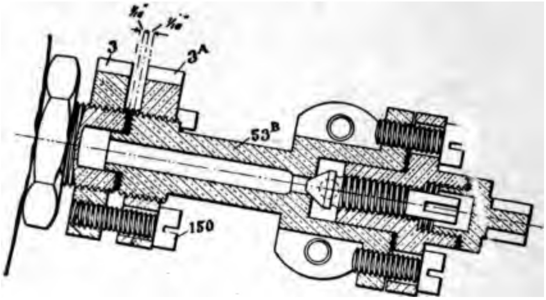


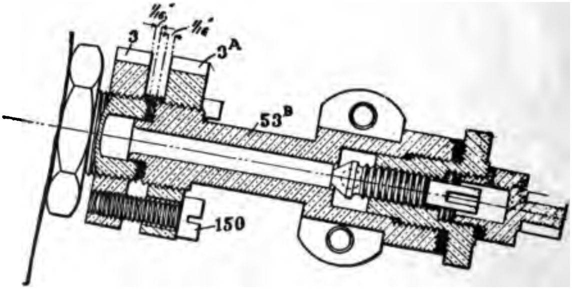
FIG. 50.

as desired, but they have to be far enough back to insure that the filling valve does not project beyond the edge of the car body. The brackets are usually located between the end of the holder and a needle beam. The gauge should be enclosed in a box with a glass face and screwed to the under side of the car as shown in Figure 47.

The pipes are bent for gas under pressure, as shown in Figures 46, 47, 48 and 49. All pipes are usually made to drain to the holder fittings (53b) and the gauge pipe must drain to the fitting (12). The threads on the bent pipes are tinned, and are fitted in place after the flanges are screwed on. The brass flanges, etc., are thoroughly soldered to the pipes when all the pipes for gas under pressure have been fitted. The pipe leading to No. 65 is put through (118a) before No. 9 is soldered on. Filling bracket (118a) is then securely fastened to the car and all the pipes strapped up securely.



OLD FORM.



PRESENT FORM.

FIG. 51.

The filling valve and cover (65) (89) are attached by removing the cover (89) from the valve (65) and bolting valve to the bracket. This is done by opening port covers P and T, unscrewing and removing packing nut R (but set screw B should not be unscrewed should valve stem nut M be loosened), screws (148) are taken out and No. 89 is held to the back flange of the No. 65 valve and the threaded end of the valve is rapped on a block of wood.

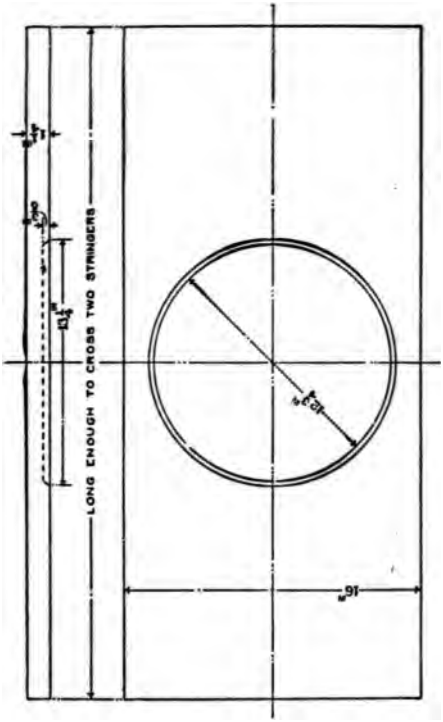


FIG. 52.

The number and character of fixtures required for the proper equipment of any car depends upon the class or kind of the car, the divisions of its space (as into staterooms, toilets, smoking-rooms, passageways, etc.), the spacings of the ceilings or headlinings, and the amount of light required in the particular service for which the car is destined.

The consumption for each kind of lamp is about as follows:

4 flame lamps, 2½ cubic feet per hour.
2 flame lamps, 1½ cubic feet per hour.
Vestibule lamps, 1 cubic foot per hour.
1 flame bracket, ¾ of a cubic foot per hour.
Argand bracket, 2½ cubic feet per hour.

The necessary number and sizes of holders or tanks is figured from the above calculated results, combined with the following:

A holder 9′ 6″ long, 20½″ diam. contains when filled to 10 atm.* 211.8 cubic feet.

A holder 8′ 6″ long, 20½″ diam. contains when filled to 10 atm. 188 cubic feet.

A holder 7′ 10″ long, 20½″ diam. contains when filled to 10 atm. 175 cubic feet.

---

*Ten atmospheres is the standard pressure to which cars are filled, and is therefore taken as the basis of calculation.

The term "Atmosphere" (atm.) is used to indicate the pressure of the gas in the holders. Each atmosphere as indicated by the Pintsch gauges is 14 7/10 pounds per square inch above the outside air. The gauge, connected with a holder into which its own cubical contents of gas has been forced, will indicate one atmosphere increase in pressure. If twice its cubical contents has been forced in, then the gauge will show two atmospheres increase in pressure. If ten times, then ten atmospheres. Each atmosphere of pressure indicated, multiplied by the cubical volume of the holder or holders, gives the available gas supply. Example—A car with two holders, each of 18.8 cubic feet of volume, and filled to 8 atmospheres, has on hand as available gas 2 x 18.8 x 8 = 300.8 cubic feet. When filled to 10 atmospheres these holders would contain 376 cubic feet, and would supply five four-flame lamps, two vestibule lamps and two bracket lamps, consuming altogether 16 cubic feet an hour, for about 24 *hours' full burning.*

A holder 7′ 2¼″ long, 20½″ diam. contains when filled to 10 atm. 157 cubic feet.

A holder 6′ 1″ long, 20½″ diam. contains when filled to 10 atm. 135 cubic feet.

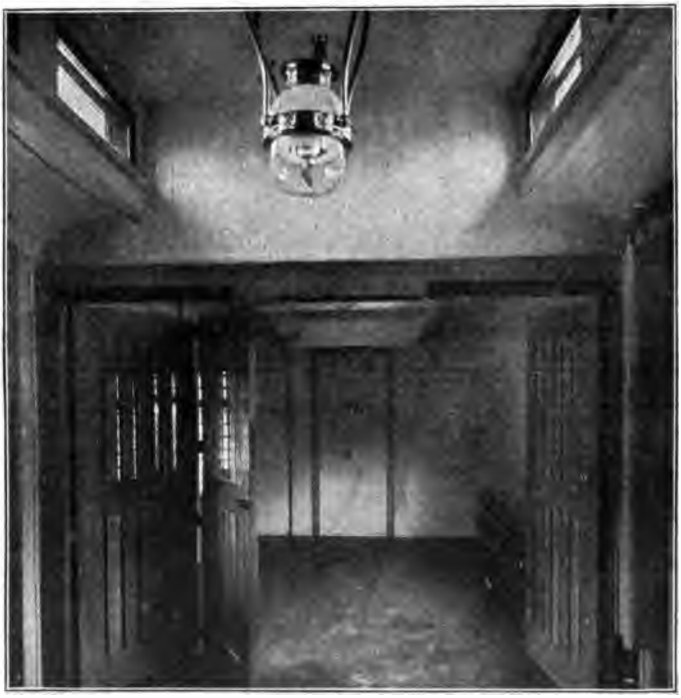


FIG. 53. SHOWING A TWO-FLAME ORDINARY PINTSCH GAS LAMP, IN BAGGAGE CAR.

A holder 6′ 1″ long, 18½″ diam. contains when filled to 10 atm. 110 cubic feet.

A holder 6′ 1″ long, 16½″ diam. contains when filled to 10 atm. 88.5 cubic feet.

One of the ordinary style two-flame burners is shown in Figure 53, illustrating its application to a baggage car.

Special inverted mantle burners for use with Pintsch gas are now used. By their use it is claimed a steady white light is produced and the candle increased more than three fold. The regulator has to be arranged so as to give an outlet pressure of one pound per square inch.

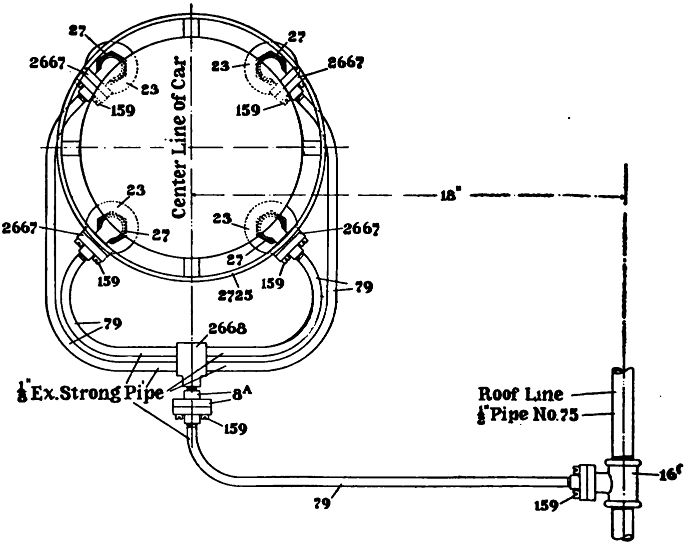


FIG. 54. THE REGULATOR USED WITH THE MANTLES FOR INVERTED BURNERS.

See Figure 54. This illustration shows the gas pipe connections for two mantle lamps, as shown in Figure 55, which gives the details of the lamp, arrangement of parts and shows the flow of gas. The delivery of gas is the same as for ordinary lamps, until it reaches fitting

2615, which has at its end nearest the burner a very fine drilling through which the gas issues, mixing itself with the air which burns with a jet downwardly into the globe 2603A. The mantle is designated by 2640.

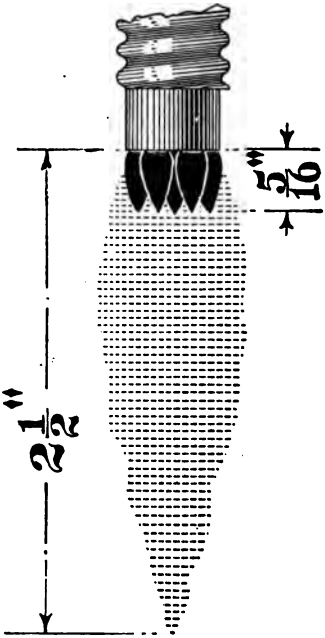


FIG. 56. SHOWING PROPER FLAME.

The proper flame from the burner is shown in Figure 56. This flame has seven short light blue cones surrounded by a very light gaseous flame.

To light the lamps: If the main cock is closed it should be opened full, then the lamp cock should be opened, and the flame of a match or taper held just

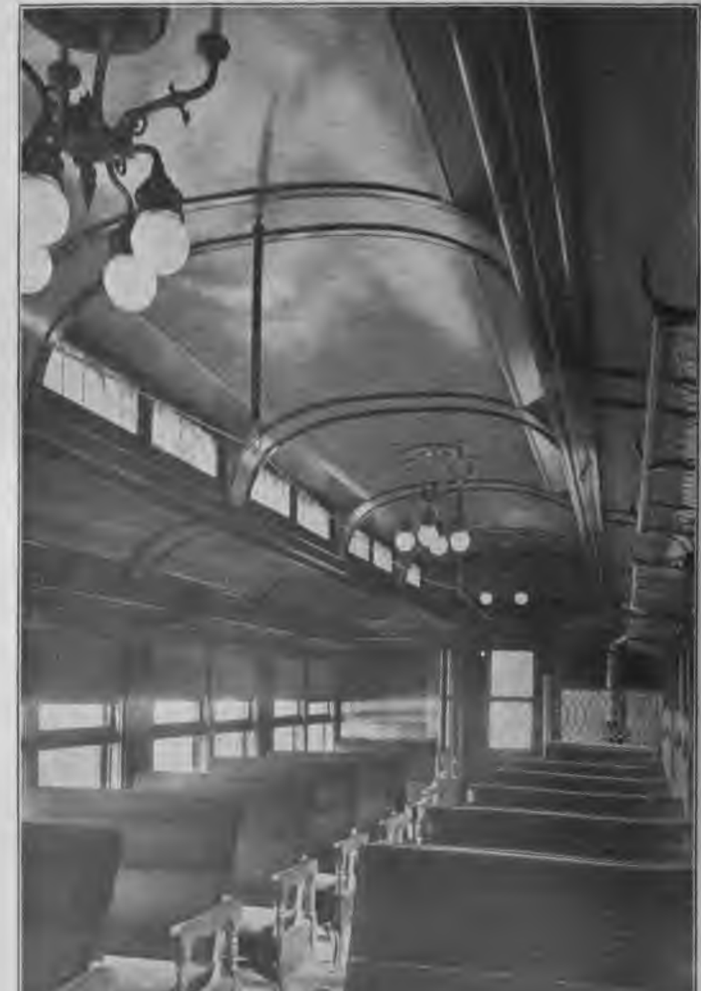


FIG. 57. INVERTED BURNER LAMPS IN PASSENGER COACH.

at the bottom opening of each small globe, the flame only being allowed to extend into the globe.

To extinguish lights: Simply turn off the gas at each gas cock.

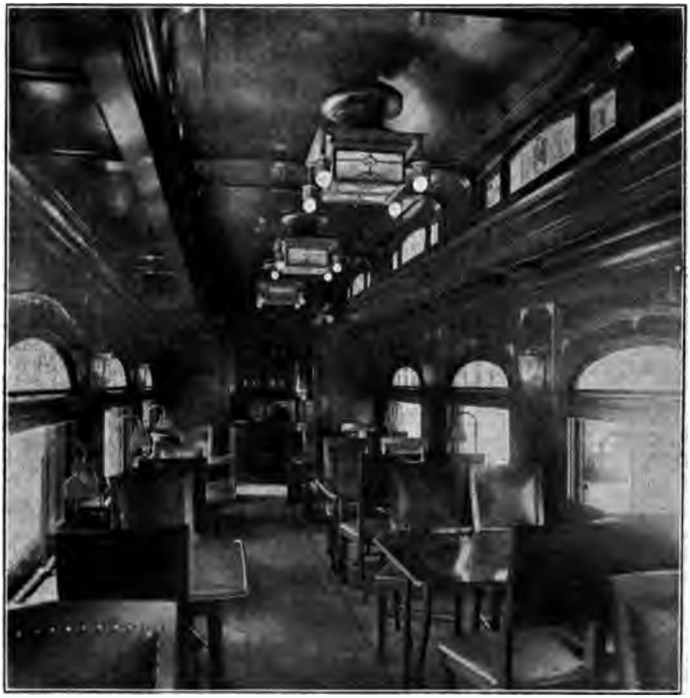


FIG. 58. INVERTED BURNER LAMPS IN DINING CAR.

Care of mantles: When a burner becomes defective it is indicated by an inferior light. In which case a new bulb should be substituted. To do this the light should be extinguished and when cool enough the glass bulb and its holder should be removed. Care should be taken to see that the holder unscrews with the bulb. Then light all flames and if any are found to be defective, there is probably some obstruction in the gas supply. In which case, it should be reported at the terminal, as should all other matters in connection with the lighting apparatus needing attention. When a new bulb is substituted it should be screwed slowly on the lamp with the flame burning.

Two styles of lamps in which inverted mantles are used in connection with Pintsch gas are shown in Figures 57 and 58, one illustrating the lighting of a passenger coach, and the other a dining car.

INSTRUCTIONS TO FOREMEN AND INSPECTORS FOR THE USE OF PINTSCH GAS EQUIPMENT AT TERMINAL POINTS.

When a gas car arrives at a terminal, the lamps should be thoroughly cleaned and carefully looked over, and if any parts are found to be defective, repairs must be made promptly. After testing, and replacing all defects, close cock at each lamp separately, then close main cock in gent's toilet room, using gas key furnished for that purpose.

See Trainmen's Rule posted in toilet room in regard to turning off lamps first, then shut off main cock. Also that mantle lamps must be turned on full, or turned off entirely.

Lampmen and Inspectors must report immediately if a car is found with lamps turned on and main cock turned off in toilet room, and report made to Car Foreman or Master Car Builder.

The small pipes under the car connecting the tanks, regulator, and filling valves are made of ¼ in. extra heavy iron pipe with brass flanges soldered on to connect the pipes together. A small lead washer is used between the faces of the flanges to make a tight joint, slot headed bolts used to draw the flanges together.

Should a leak be discovered in these flanges, the leak may be stopped by tightening the slot headed bolts in the brass flanges with a screw driver. If leak does not then stop, remove old and apply new washer.

Should it become necessary to disconnect these pipes to re-solder a joint or to replace a washer, the gas will have to be shut off at tank valves. This must be done by removing cap from tank valve which will expose stem of tank valve, turn these stems to the right until valves are closed, using same kind of brass key as in toilet room.

After these connections are repaired, turn on the gas at tank valves, replace valve caps and see that all joints are tight.

Never use a light to locate leaks. Depend on the sense of smell or use soap suds applied with a brush.

If a filling valve should be found to be leaking it may be stopped by being turned down tighter by brass key from toilet room. These valves are left hand, to shut them off turn them to the left.

Should a filling valve leak so badly that it cannot be repaired the gas must be turned off at the tanks, and the Foreman notified.

INSTRUCTIONS TO TRAINMEN FOR THE CARE OF PINTSCH GAS CAR EQUIPMENT.

Read instructions to trainmen in regard to lighting lamps and emergency outfit which is posted in toilet rooms.

Before the gas is turned on at the main cock in the toilet room see that all lamps in the main part of the car and the bracket lamps in the passageways and toilet rooms are turned off. After the gas has been turned on at the main cock in the toilet room all lamps may be lighted.

Should one of the lamps be leaky or defective, turn it off and report it at the next terminal point to the Car Foreman, or the man in charge of the lamps.

Should lights fail when there is gas in the tanks, thaw out the gas regulator under the car with steam or hot water.

Should a leak be discovered in any part of the car the gas *must* be shut off at once at the main cock in the toilet room.

Should a leak occur in the filling valve under the car or in the connections between the gas tanks, the gas must be turned off at both tanks. To do this, take brass key from toilet room, using large socket to unscrew caps of tank valves. After these have been removed, the stems of the tank valves will be exposed, then use the small socket of the key to shut off valves turning them to the right.

Torches or lamps of any kind must not be used while working around the connections and tanks under the car. and any employe looking for a leak with a light will be discharged.

In turning off the light turn off each lamp separately. After that is done turn off the gas at the main cock in the toilet room.

Should the odor of gas be detected in any part of the car, report it promptly to the Car Foreman, Inspector, or man in charge of lamps, at the next terminal point.

Trainmen must use discretion in regard to using the light during their respective runs. In first class and second class coaches where there are four or five centre lamps in the body of the car it will be sufficient to have two lamps burning after 11 p. m. The balance should be shut off entirely. In sleeping cars lamps should be turned out in the main body of the car, as per general instructions.

After 12 o'clock midnight the lamps in sleeping car smoking rooms should also be turned out.

GOLD'S IMPROVED SYSTEM OF ACETYLENE CAR LIGHTING.

The gas generator may be either inclosed in a locker, toilet room, or any other convenient part of a car or may be put in one corner of a car without being enclosed in any way. Its appearance is neat, the absence of moving parts or complicated valves makes it possible to place it in any desired position in a car. All the charging and cleaning is done from the outside of the car, as the only inside connections are permanent ones. The charging and cleaning is done by car men and is only done at terminals. The gas is made by the generators only as needed and the apparatus needs no attention from trainmen, beyond the lighting and putting out of lamps. The amount of carbide a generator will hold is enough for several nights, and recharging may be done at any point to which carbide can be shipped, thus no charging plants are necessary. It is claimed by the makers that a burner will last for years without renewal, thus there is no occasion for continual renewal of burner parts as in the mantle system.

Figure 59 shows the interior of a second class coach with gas generator installed. The cylindrical generator passing through the car from floor to roof; the water tank over the door, the condenser in the corner of the clear deck, gas outlet pipe from the generator to the bottom of the condenser and gas pipe coming out the side of the condenser. A cut-out cock is shown on the gas pipe to the condenser for cutting off the generator at terminal when being charged.

A charge of 140 pounds of carbide is put into the generator from the roof of the car. The water tank holding sufficient supply of water has an extension up through the roof where water is also supplied from without. An outlet is provided beneath the floor of the car for cleaning out the residue at the end of long runs, or after four or five nights' heavy service, as cars equipped with these generators are in transcontinental service as well as running on remote branch lines. When the car equipped with this generator leaves the terminal,

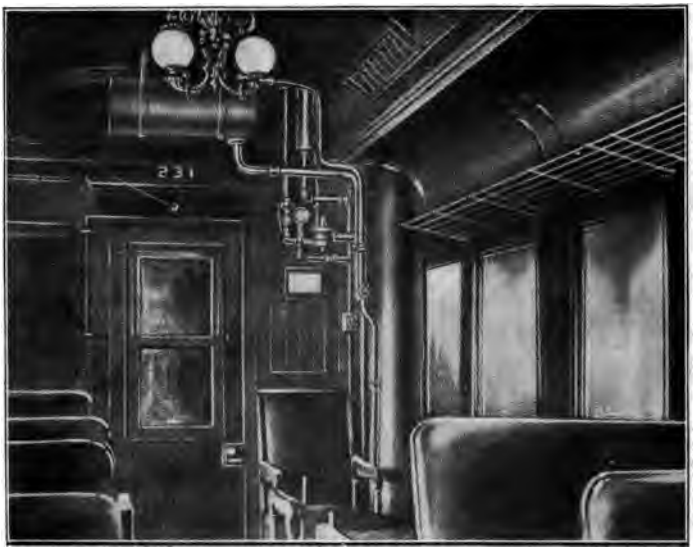


FIG. 59. INTERIOR OF COACH, WITH GAS GENERATOR INSTALLED.

train crews and porters light or turn off the gas the same as one does at his city residence; the generator supplying the gas according to the consumption. All attendance to the generator is done by the car men while the cars are in the yards being cleaned.

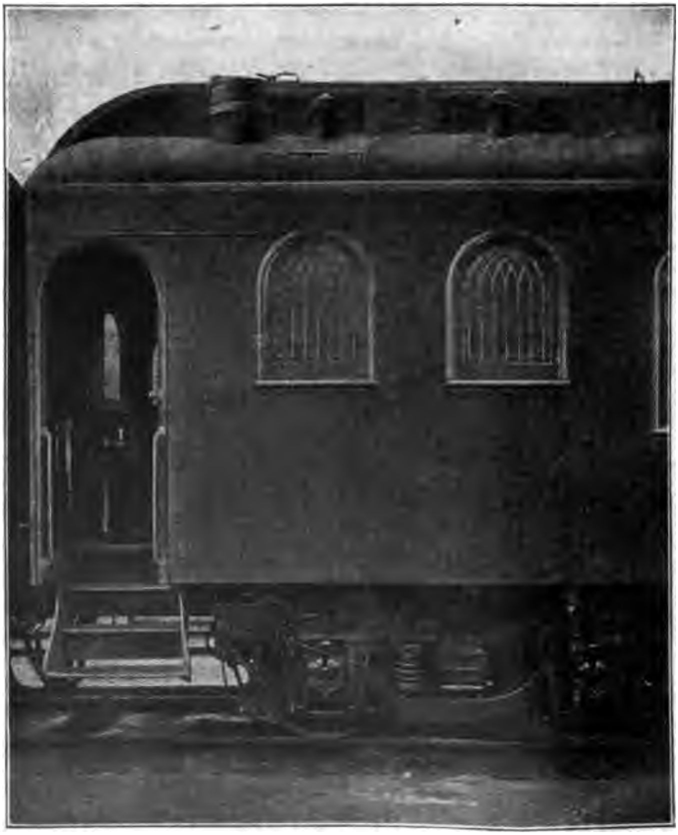


FIG. 60. TOP OF GENERATOR PROJECTING THROUGH ROOF OF SLEEPING CAR.

Figure 60 shows a view of a compartment sleeping car, the top of the generator, it will be noticed, is projecting through the roof. This generator applied to a coach is shown in Figure 61. The simplicity of the generator is plainly indicated with its carbide chamber at the top extended downward about three feet and terminating in a grating to form the bottom of this receptacle. The bottom being filled with water and connecting with the overhead supply tank which raises the water up to the grate where it comes in contact with the carbide generating gas as it does so, and at the same time slacking the carbide, allowing the residue to drop down to the bottom of the generator. This forms a slight pressure above the water, causing it to recede until the gas is sufficiently drawn off in using, thus automatically regulating the making of gas according to the consumption.

Other accompanying apparatus is used, but such as does not in any way complicate the installation as a whole. A condenser, storage reservoir and regulator to insure pure dry gas at a steady pressure, giving the soft white light characteristic of this gas.

In the event of accidents there is no escape of highly compressed gas to be contended with. The generator is provided with a safety valve which would not allow building up any high pressure under any emergency, and the system which causes the water to recede when a pressure is built up which exceeds the weight of the column of water due to the height of the water supply perfectly controls the ordinary pressure of gas in the system.

Cars equipped with the Pintsch gas system can be

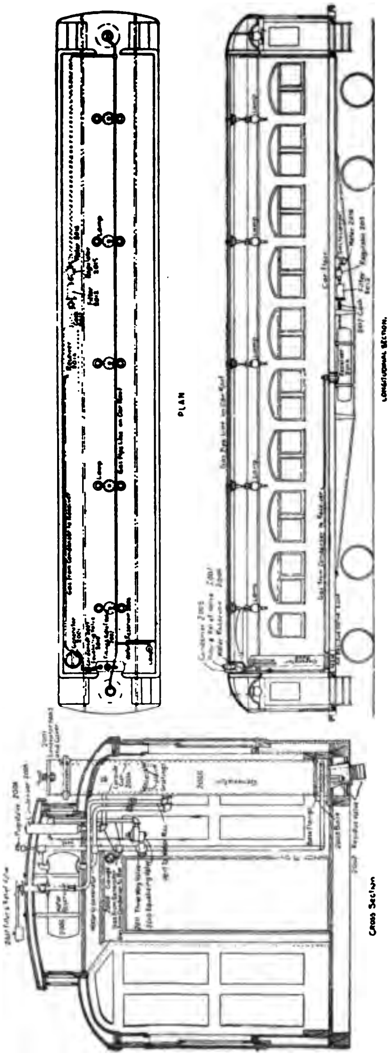


FIG. 61. GENERATOR APPLIED TO A COACH—SECTIONAL VIEW.

converted to this system when desired, the same lamps being changed over to suit, or new ones of special design substituted.

THE SAFETY STORAGE SYSTEM OF ACETYLENE LIGHTING FOR RAILWAY CARS.

This system of lighting is similar to other gas storage systems, in that it consists of a cylindrical tank charged with gas, in connection with which are a pressure regulating valve and pressure gauge, all of which are placed under the car.

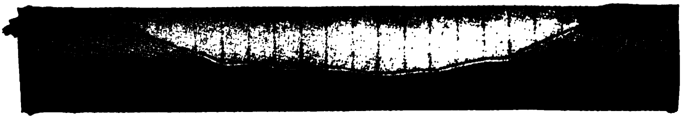


FIG. 62. SAFETY STORAGE TANK BROKEN TO SHOW THE ASBESTOS DISCS.

The tanks used in the Commercial Acetylene Company's patented safety storage system contain no free gas. They are packed with asbestos discs, as shown in Figure 62, before the ends are brazed in. This asbestos is then saturated with acetone (a species of wood alcohol) which, at ten atmospheres, or 150 pounds pressure, absorbs twenty-five times its own volume of the gas at a normal temperature, thereby increasing the storage capacity of the tank ten-fold. The regular railway cylinder is a trifle smaller than those used in other gas storage systems, measuring 114″ in length by 20″ in diameter; at a charging pressure of 150 pounds it will contain 2,000 cubic feet of gas.

Though the tremendous storage capacity is realized, what it really means is better understood when the high candle power of the gas is appreciated. For instance, one cubic foot yields 50 candle power. Thus a tank of 2,000 cubic feet equals 100,000 candle power; enough to light a car for several transcontinental trips.

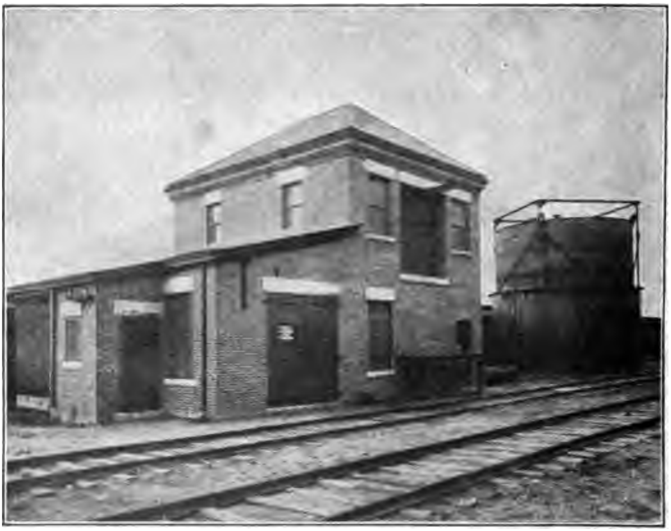


FIG. 63. CHARGING PLANT OF THE N. Y., N. H. & H. R. R., PROVIDENCE, R. I., SHOWING 5,000 CU. FT. HOLDER.

The generating and compressing plant consists of a two-story building for the generating, with a one-story addition for the compressing room, with room for motor on side, and a shed containing the storage cylinders in back. (See Figures 63, 64, 65, 66 and 67.)

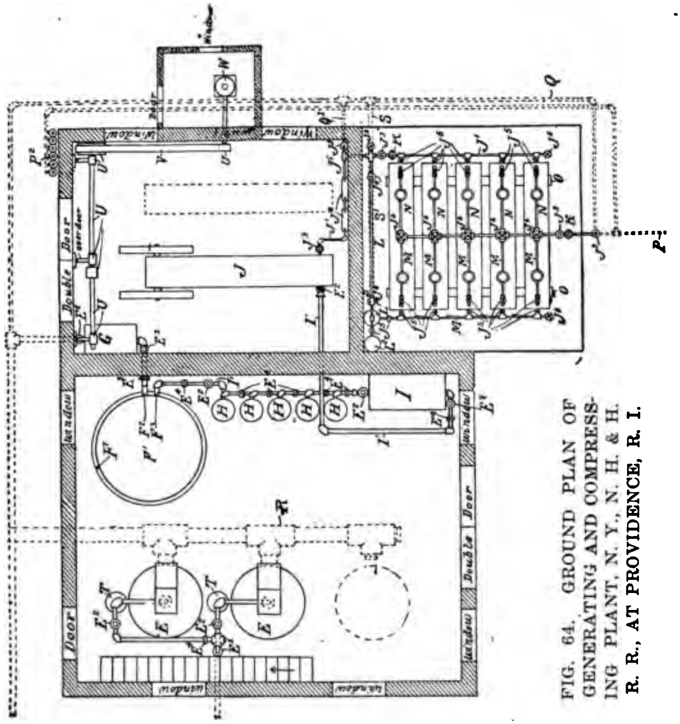
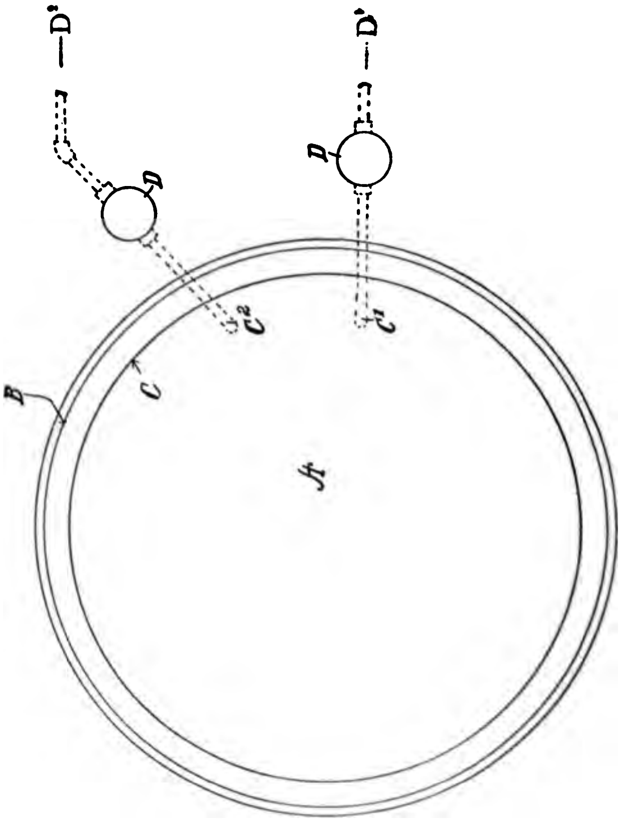


FIG. 64. GROUND PLAN OF GENERATING AND COMPRESSING PLANT, N. Y., N. H. & H. R. R., AT PROVIDENCE, R. I.

E—Generators.
E1—4" Gate Valves.
E2—3" Gate Valves.
E3—4" Flanged Unions.
E4—3" Flanged Unions.
F—Cushion Holder Tank.
F1—Bell of Cushion Holder.
F2—4" Inlet to Cushion Holder.
F3—3" Outlet from Cushion Holder.
G—Meter.
H—Dryer Cylinders.
I—Scrubber.
I1—3" Main to Compressor.
J—Compressor.
J1—¾" H. P. Line to Storage Cylinders.
J2—Oil Separators.
J3—¾" H. P. Globe Valves.
J4—¼" H. P. Globe Valves.
J5—¼" H. P. Globe Valves.
J6—¾" Pop Valves.
K—Filter Cases.
L—½" H. P. Line to Acetone Cylinder.
L1—Acetone Cylinder.
L2—Acetone Filler.
M—¼" Special Steel Pipe.
N—Storage Cylinders.
O—Saddles for Storage Cylinders.
P—Yard Line.
P1—Yard Line Valves.
P2—Nest of Valves for Charging Cylinders on Flat Cars.
Q—¾" Pipe to Release Gas in Yard Line Back to Holder.
Q1—¾" Pipe to Release Gas in Compressor Back to Holder.
R—12" Connection to Sewer.
S—¾" Pipe to Release Acetone Cylinder Back to Holder.
T—Water Seal Blow-Off.
U—Shafting, Hangers and Pulleys.
V—Belt.
W—Motor.



Ground Plan of Gas Holder.

FIG. 65. GENERATING AND COMPRESSING PLANT, N. Y., N. H. & H. R. R., AT PROVIDENCE, R. I.

A—Gas Holder.
B—Tank of Gas Holder.
C—Bell of Gas Holder.
C1—Inlet to Gas Holder.
C2—Outlet from Gas Holder.
D—Drip Pots.
D1—4" Main to Holder.
D2—4" Return Main.

These plans in detail apply to all charging plants built for this system of lighting, the various sizes varying, of course, according *to the capacity* of the plant

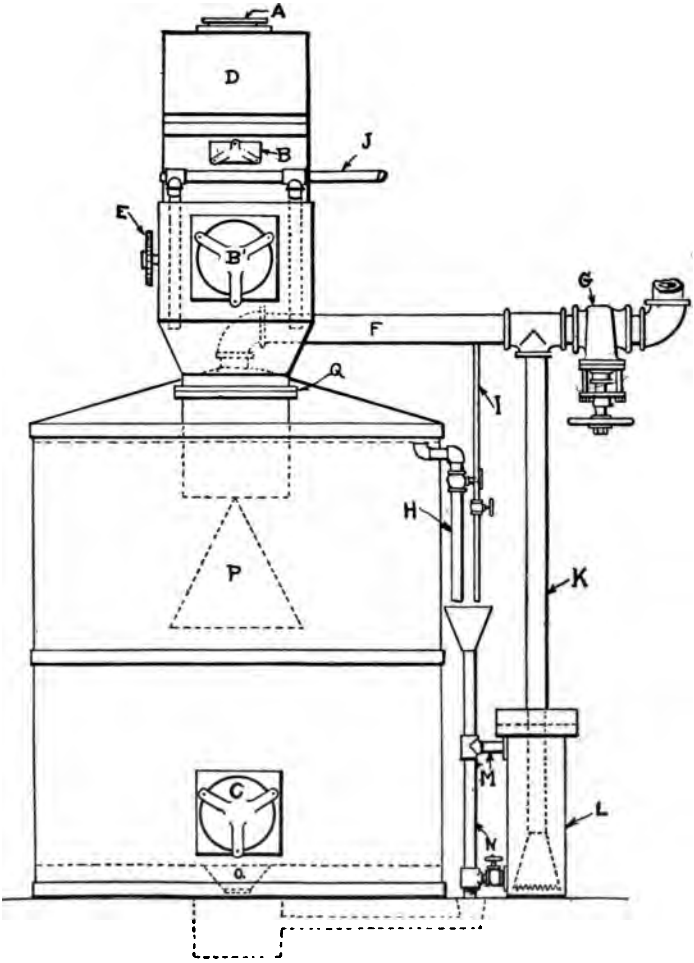


FIG. 66. GENERAL ACETYLENE GENERATOR.

SEE PAGE 160 FOR EXPLANATION.

EXPLANATION OF FIG. 66.

A—Hand Hole through which Hopper is filled with Carbide.
B—Hand Hole for cleaning Feed Drum.
C—Hand Hole giving access to Generating Chamber.
D—Carbide Hopper.
E—Rachet Wheel operating Feed Drum.
F—Gas Main from Generator.
G—Gate Valve.
H—Over Flow Pipe.
I—Vent Pipe.
J—Water Supply Pipe.
K—Blow Off Pipe.
L—Blow Off Seal.
M—Blow Off Seal Overflow.
N—Drain Pipe.
O—Drain Valve.
P—Carbide Deflector.
Q—Flange Joint connecting Hopper with Generating Chamber.

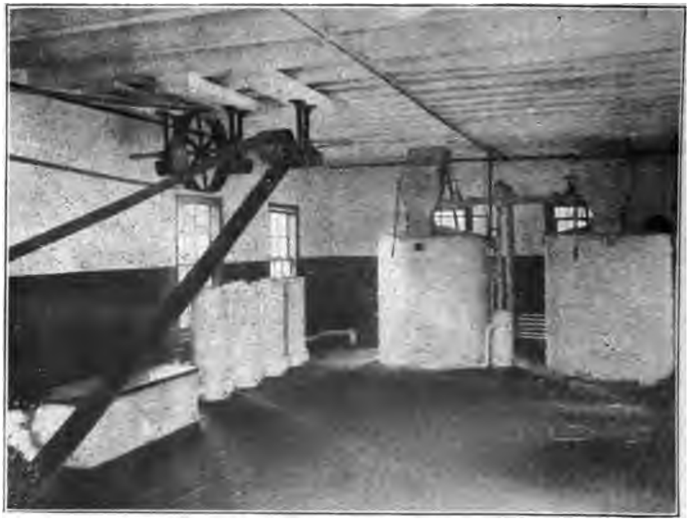


FIG. 67. GENERATING AND COMPRESSING PLANT OF THE D. L. & W. R. R. AT HOBOKEN, N. J.

South end of first floor, showing: two General Acetylene Generators *with Carbide* Chamber or Hopper passing up through ceiling to second *floor, 4 Driers,* 1 Scrubber.

The hoppers, or carbide chambers, of the generators run up through the ceiling of generating room, and the carbide is fed into same from the second floor, which is also used for storage of carbide.

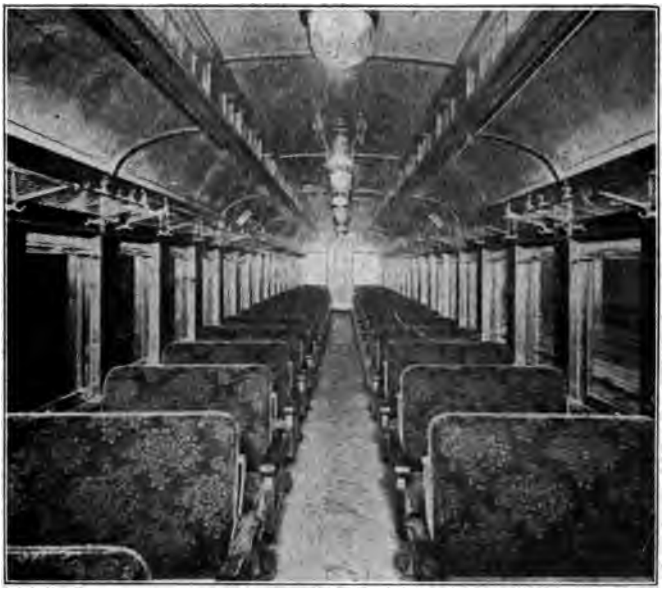


FIG. 68. N. Y. C. & H. R. R. DAY COACH EQUIPPED WITH THE SAFETY STORAGE SYSTEM.
(Converted Pintsch Lamps.)

Where meter is not desired, the cushion bell, F′, can be dispensed with, as its use is only to equalize the flow through meter and protect it from the drag of the *compressor's* intake.

This system of lighting is shown in a series of illustrations showing the interiors of a day coach and a mail car, and also a café car. The exterior of a standard coach is shown likewise to indicate the storage tank, etc. See Figures 68, 69, 70 and 71.

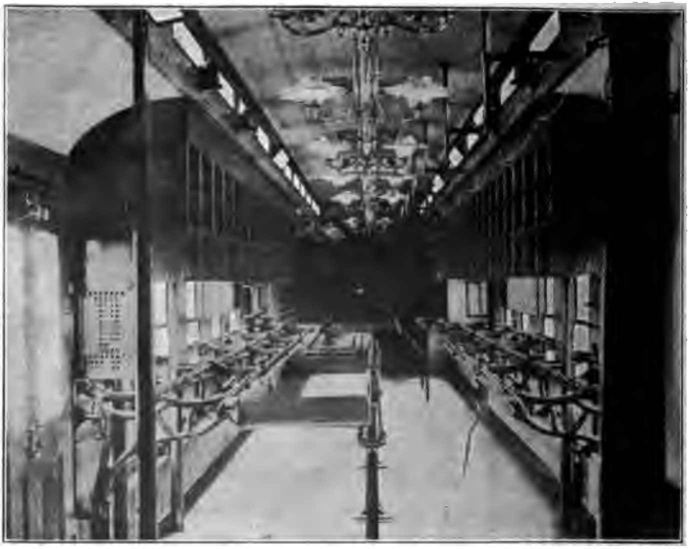


FIG. 69. ERIE MAIL CAR 699
Built by Standard Steel Car Co., Equipped with the **Safety Storage** System. Finest Lighted Car in the World.

Sections of cars showing the equipment, and also the names of parts are illustrated in Figure 72.

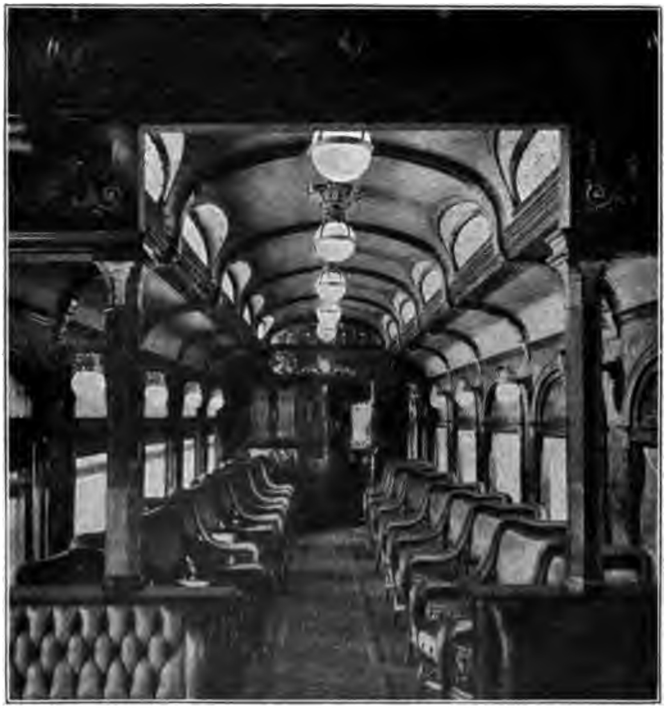


FIG. 70. D., L. & W. CAFE CAR 781.
Equipped with the Safety Storage System.

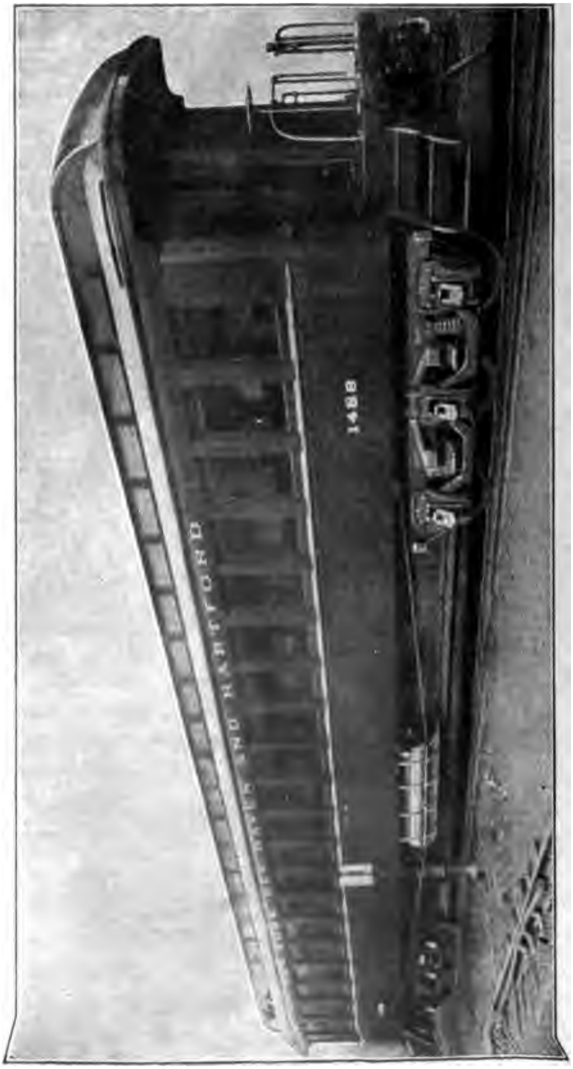


FIG. 71. N. Y., N. H. & H. CAR EQUIPPED WITH THE SAFETY STORAGE SYSTEM.

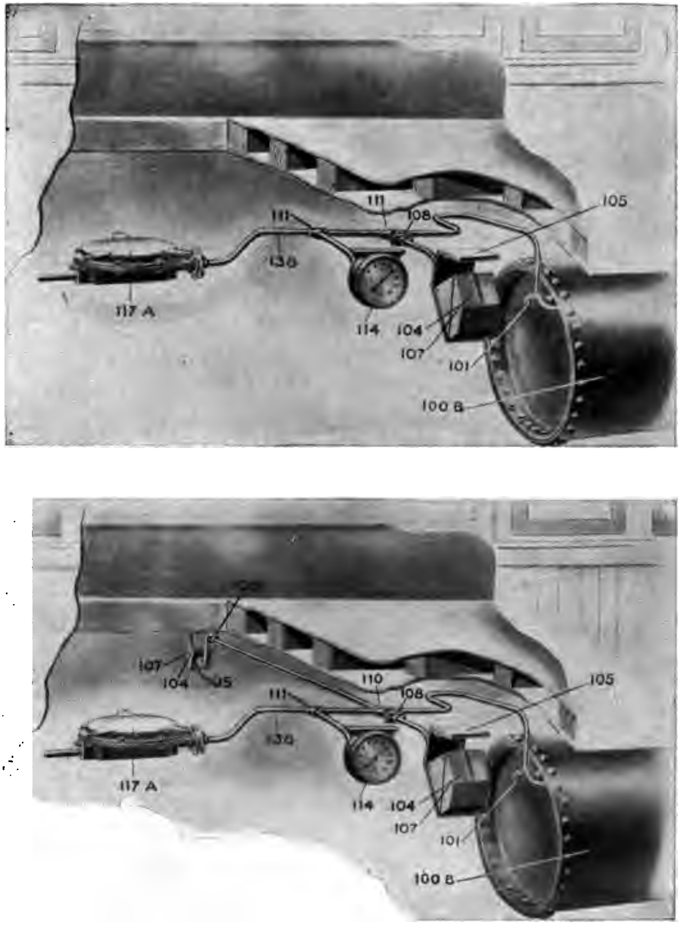


FIG. 72. SECTIONS OF CARS SHOWING EQUIPMENT.

101—Stud Valve.
104—Filling Valve.
105—Filling Valve Bracket.
107—Filling Valve Cover.
108—¼" Flange Union-(H.P.)
110—¼" Steel Cross.
111—¼" Steel Tee.
114—Gauge for Car.
117—A Regulating Valve.
138—¼" Extra Strong P

THE ELECTRIC CAR LIGHTING SYSTEM.

The electric lighting of cars by the Bliss system consists essentially of the following apparatus:—

1. A dynamo electric machine or generator, mounted upon the truck frame and so arranged that its armature is rotated by means of a mechanical connection with the axle.

2. A regulator mounted upon the bottom of the car body, the function of which is to control the generator output, and to maintain constant the lamp voltage, irrespective of the speed of the car or the number of lamps in use.

3. An automatic switch, mounted inside the car, the function of which is to control the connection of the generator with the rest of the system.

In addition to these three elementary devices, an electrically lighted car must be equipped with: *First,* a suitable storage battery, and *Second,* the usual wiring, fixtures, lamps, circuit switches, etc., as may be necessary.

The apparatus consists of the three essential elements above mentioned, namely, generator, regulator and automatic switch, together with certain minor auxiliary parts, the function of which is of a protective nature, or which promote convenience in installation.

GENERATOR.—The generator in operation is essentially similiar to a stationary generator used for ordinary lighting work.

REGULATOR OR "BUCKER."—In any car lighting system *employing* a variable speed generator, it is necessary to provide regulation in two circuits: *First,* the generator field circuit to prevent undue increase in voltage as the speed increases, and *Second,* between the battery terminals and the lamp mains, to prevent the full charging voltage of the battery being impressed on the lamps. In the ordinary system, this regulation is obtained more or less effectually by means of automatically operated rheostats. In the Bliss System, the automatic rheostat with the attendant mechanical complications, is eliminated, and regulation is obtained by opposing the flow of the current by means of counter voltage, which varies with the operating conditions. This counter voltage may be said to "buck" the current which tends to flow through the generator field circuit, and also from the battery terminals to the lamps, and in conse-

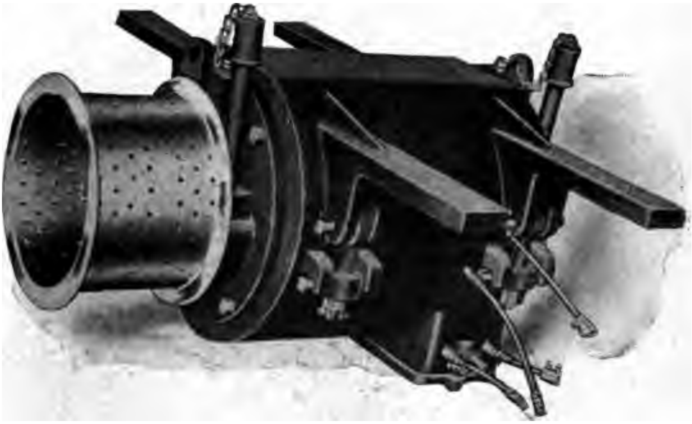


FIG. 73. GENERATOR SHOWING PERFORATED PULLEY AND SUPPORTING ARMS.

quence of this action, the regulator has come to be generally termed the "Bucker."

Mechanically considered, it consists of two armatures of sufficient size to permit rugged construction, both mounted on a single shaft, and enclosed within a single casing. One of these armatures, with its corresponding field, forms a simple shunt motor, and the other armature constitutes the regulating device and is provided with two windings and two commutators, one connected in the generator field circuit, and the other between the battery terminals and the lamps.

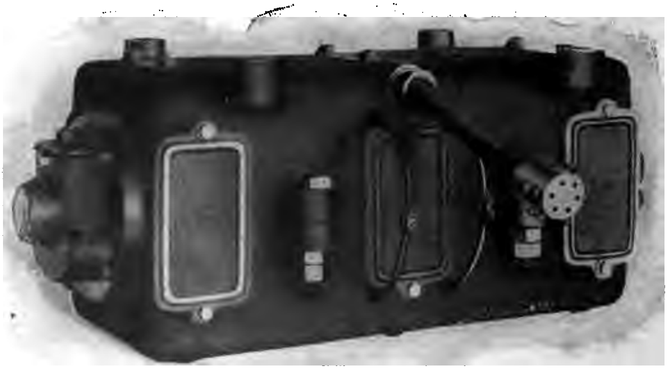


FIG. 74. SIDE VIEW OF BUCKER SHOWING COUPLER HEAD.

The required counter voltages are generated automatically in these two windings, one providing the necessary regulation for the generator field as the speed increases, and the other increasing as the charging voltage of the battery increases, thus keeping the lamp voltage constant.

Automatic Switch.—The connection between the generator and the rest of the system is controlled by means of an automatic device called the "generator switch." It is simply a solenoid composed of two coils, one the lifting or closing coil, the other the releasing or opening coil. These coils act upon a plunger, which is drawn up by the lifting coil. When so drawn up, a metal brush attached to the plunger connects two terminals thus connecting the generator to the battery. The solenoid switch closes the connection between the main wires when the generator has attained an operating speed and opens automatically when the generator drops below the operating speed.

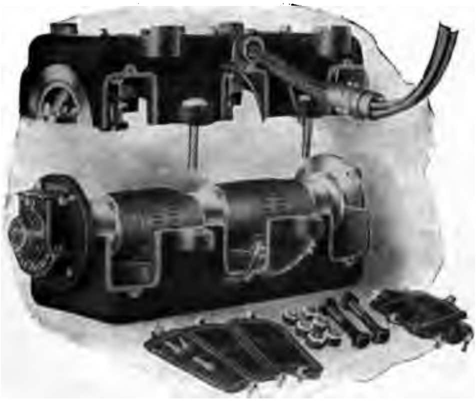


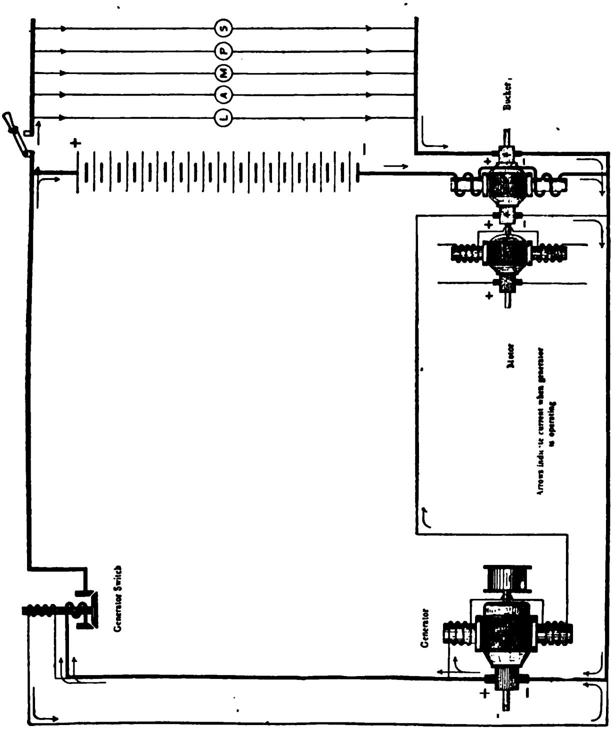
FIG. 75. BUCKER WITH LOWER FRAME REMOVED SHOWING ARMATURE IN LOWER FRAME.

Storage Battery.—In general, two groupings of storage battery have been standardized for railroad work, *i. e.*, 16 cells with operating voltage of 30 to 32, and 32 cells with operating voltage of 60 to 64. Where only single car lighting is considered, it is probable that neither system presents any marked advantage over the other, and decision has been based on individual operating conditions.

The 16-cell equipment reduces the number of connections in the battery, and also tends to reduce the cost of inspection and maintenance, on account of the smaller number of battery units. The 32-cell system, on the contrary, entails more apparent complication and inspection, but in the minds of many this is compensated for by the reduction in wiring cost, and the assurance of more perfect operation, due to the smaller currents to be handled.

Where any extended system of train lighting, as distinguished from car lighting, is considered, the 32-cell system has been almost universally adopted, and the 16-cell system has been set aside on account of the enormously increased copper section necessary to carry the current, and the difficulty of providing sufficient contact surface in connectors. In consequence, where an extended system of lighting is considered, the decision should be in favor of the higher voltage and increased number of cells, even on single car lighting apparatus, in order that the equipment may be interchange-throughout, so far as is possible.

WIRING, FIXTURES AND LAMPS.—Car wiring and fixtures may be as ornate and elaborate or as plain and simple as taste or expediency may dictate. Lamp practice, however, has become fairly standardized. Both 30 and 60-volt lamps are procurable in 6, 8, 10, 12 and 16 C. P. sizes, the 8 C. P. lamp being the one most universally sed. The 30-volt lamp, in general, has the advantage hat its filament is short, of greater cross-section, and conequently less affected by vibration. The 60-volt lamp, n the contrary is generally cheaper, easier to procure and ; considered less special than the 30-volt by the lamp anufacturers.



Partial Theoretical Wiring Diagram

FIG. 76. PARTIAL THEORETICAL WIRING DIAGRAM.

Under normal conditions, the Bliss single car equipent has a capacity of 2,200 watts in the lamp circuit, addition to the current which simultaneously charges the batteries, thus providing lighting for from 70 tc eight C. P. lamps, this being the maximum which is c narily installed. As pointed out later the maximum put capacity of the generator is in excess of this fig

General Operation.—As the car accelerates, the g erator developes an increasing voltage, sending cur through the various circuits connected with it, and st ing the motor armature of the bucker. When the reaches the operating speed, the generator will dev normal lamp voltage and the motor and bucker will running at full speed.

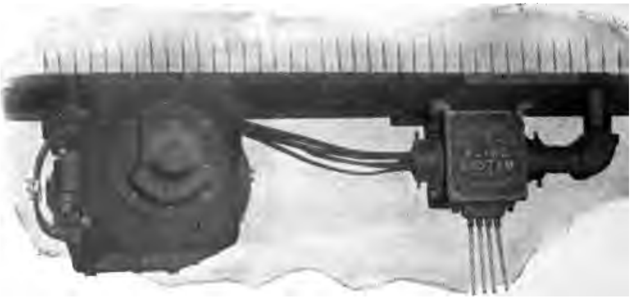


FIG. 77. RELATIVE POSITION OF BUCKER AND JUNCT BOX ON BOTTOM OF CAR BODY.

At this point, the automatic switch closes, connect the generator to the rest of the system, and the feec of current to the lamps begins.

On further increase of speed, which would tend to respondingly increase the voltage, the opposing influe of the bucker in the field circuit comes into play, we ening the field as the speed increases, and keeping *output of* the generator within the predetermined lin *At the same* time the opposing effect of the bucker in lamp circuit takes effect, and prevents the lamp voltage from rising co-incident with the speed and voltage of the generator as the car increases in speed. The apparatus is so adjusted that even at train speeds of 75 miles per hour or higher, the output of the generator is confined within safe limits by the field bucker winding, and the lamp voltage is maintained constant at its normal value through the action of the lamp bucker winding, thus meeting all operating conditions.

In addition, the lamp voltage will remain constant, irrespective of the number of lamps in use, since the "bucking" effect is the same irrespective of the current which may flow against it. This is not true in rheostatic regulation, in which the amount of resistance must be varied, not only as the battery voltage changes, but as the number of lamps may be altered.

ARRANGEMENT OF CIRCUITS.—By reference to the wiring diagram shown, it will be seen that the current flowing from the positive terminal of the generator passes through the automatic switch, and then divides, a certain portion of it passing through whatever lamps may be in use, the other portion passing through the storage battery in a charging direction, and also through the field winding of the bucker. Again, the current which has passed through the lamps, and that which has flowed through the battery and the field coil of the bucker unite and return to the negative terminal of the generator.

It will be noted that the current for exciting the field magnet of the generator flows from the positive terminal of the same through the generator shunt field, and thence through the brushes of the commutator on one side of the bucker armature. It will further be noted that the current which has passed through the lamps is caused t flow through the other set of brushes, and the other commutator of the bucker armature. The two commutators referred to are each connected to an independent winding, wound on the same core. These windings are totally distinct, and insulated from one another, the one in the circuit of the generator field being composed of a large number of turns of comparatively fine wire, while that in the lamp circuit is composed of a small number of comparatively heavy turns. On the shame shaft with this armature is another armature provided with the usual field magnet, which forms the shunt motor which has already been referred to. The connections of the shunt motor are obvious and have been omitted in the diagram for the sake of clearness.

The field coil which acts upon the bucker armature is connected so that the current which flows through the battery must pass through it, and the bucker armature being in rotation at constant speed, it is obvious that an increase in the current flow through the battery, due to increase in generator voltage, will increase the counter voltage generated by the field bucker, thus tending to weaken the generator field and reduce the increased current flow to the battery. Simultaneously, the counter voltage of the lamp bucker will be increased, thus compensating for the rise of voltage on the battery terminals and maintaining constant voltage on the lamp mains.

Essentially considered, these operations constitute the regulation provided by the Bliss System, ***and maintain*** *predetermined operating conditions in the* ***battery*** *and lamp circuits, irrespective of the speed of the* ***car.*** In this connection, it should be noted that the regulating effects do not take place by steps, as in the case of rheostatic *regulation,* but are regular and infinitesimally small *changes.*

BATTERY CURRENT REGULATION.—The connection of the bucker field coil in the battery circuit serves an important function, on which depends the satisfactory performance of the apparatus on the road. It insures that, irrespective of the lamp load, the battery shall always receive a practically constant and predetermined charge, and the batteries are thus always charged, provided the car is run sufficiently to make up the losses at terminals. No current is taken from the batteries when running at average speed, irrespective of what the lamp load may be.

"Total current regulation," on the contrary, which is the method ordinarily employed in other systems, and which inherently regulates to keep the generator output at a predetermined amount, must involve the disadvantage that the charging current is variable and uncertain. With no lamps in circuit, the charging current may be equal to the total output capacity of the generator. With all lamps lighted, the charge is not only reduced, but may even be turned into a discharge, the batteries helping the generator to carry the load. As it is impracticable to control the extent to which lights may be used on the road, and as the tendency is always to use them more than freely, it is obvious that during a considerable portion of the running time, the battery in a system employing "total current regulation" may be discharging instead of charging, as is absolutely essential to good service.

In any system employing "total current regulation" certain disadvantageous conditions result, which are inherent and cannot be avoided. The battery is charged at uncertain rates at uncertain intervals, resulting in an indeterminate condition of charge, and also total uncertainty as to battery condition at any time. This makes necessary terminal charging, which, aside from being in itself objectionable, is usually carried on under disadvantageous conditions, resulting in largely increased battery deterioration. "Battery current regulation," as employed exclusively in the Bliss System, insures charging at predetermined times and at predetermined minimum rates, thus providing that the battery is at all times fully charged. Terminal charging is eliminated, and the battery being always charged at the lowest consistent rate, deterioration is reduced to a minimum.

CAR GENERATOR—TYPE C.

Outside Suspension.

Straight Line Belt Tension—Split Frame.

Type C Generator is a truck mounted, belt driven machine supported on what is commonly known as an outside suspension. The latter consists of two 3½"x1" wrought iron suspension bars, which hook under the transom and pass over the end sill and are secured upon the latter by wrought iron or open hearth steel clamps. The details of this fastening may differ with different types of truck, but the same general plan is applicable to all M. C. B. trucks. The suspension bars extend beyond

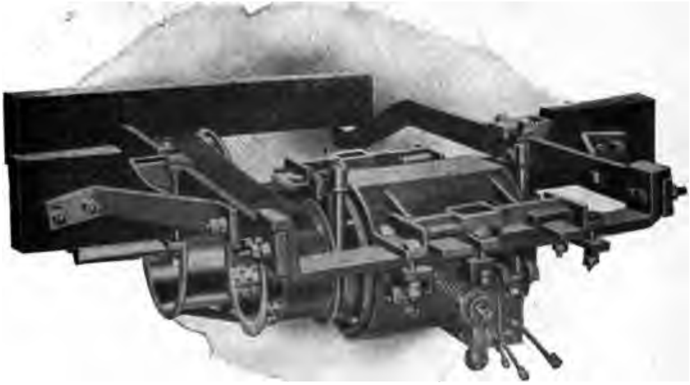


FIG. 78. CAR GENERATOR SHOWING OUTSIDE SUSPENSION, PULLEY END.

the end sill about 30″, and across their outer ends is bolted a 4″x1″ wrought iron cross bar, which is laid flat and bent downward between the suspension bars, so that its upper surface is level with and equal in width to the top of the end sill. The frame is additionally stiffened laterally by means of two diagonal wrought iron braces, bolted to the end sill and suspension bars.

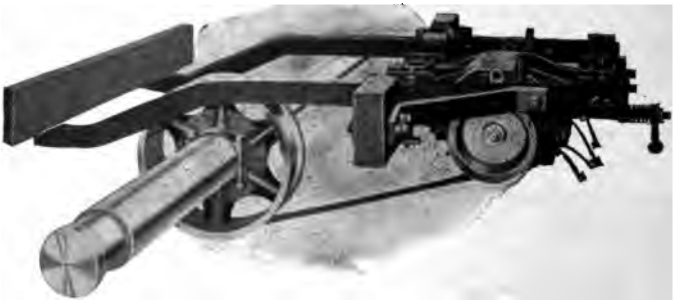


FIG. 79. SIDE VIEW OF GENERATOR SHOWING ARMATURE PULLEY, AXLE PULLEY, BELT AND TENSION MECHANISM.

Arrangement of Generator.—The frame of the generator consists of cylindrical open hearth steel casting, divided longitudinally into an upper and lower portion. Upon the upper are cast four longitudinally projecting arms or lugs, under each of which is placed a roller bearing and plate. The generator supported by these four lugs, is placed upon the end sill and cross bar, and is thus *suspended outside*, and clear of the truck. The armature shaft of the generator is set parallel with the car axle. Similar open hearth steel guides are clamped upon the end sill and cross bar, respectively, and secure the arms or lugs of the generator frame against lateral and vertical displacement, although three inches of longitudinal movement of the generator upon the suspension frame is provided to allow for adjusting the tension of the driving belt. The guide upon the end sill is secured by means of bolts and wrought iron clamps, it being unnecessary to bore any holes through the end sill.

BELT TENSION MECHANISM.—The guide upon the cross bar is interchangeable with the guide on the end sill, and is secured by bolts and clamps, one of which is an open hearth steel casting and forms, in addition, a bracket for the belt tension rod, and a seat for the belt tension spring. The tension rod is attached to the generator frame by means of a clevis and pin, passes through a hole in the tension bracket, and then through the tension spring. The tension on the latter is adjusted by means of the tension nut, which consists of an iron casting, forming a spring seat and nut, and a weighted handle, which prevents the nut from turning by vibration, and renders the use of a wrench and locking device unnecessary. The roller bearings under the supporting arms reduce the belt tension to a minimum.

PULLEYS AND BELTS.—In standard equipment, the generator is provided with a flanged pulley, 10" diameter and 6¼" face, crowned slightly, and accurately balanced. This pulley is fitted and keyed to the tapered armature shaft, and is interchangeable with the 8"x6¼" pulley and the fibre and steel pinions used on Forms 1 and 2 generator.

The axle pulley is likewise flanged, 21" or 23" diameter, 7" face and is flat. It is split and provided with a split bushing which is bored to fit the taper of the axle, and is clamped thereon by means of ¾" bolts. Any form of belt may be used, but should not be more than

5″ wide, and in thickness no lighter than the equivalent of four-ply rubber. One belt of proper dimensions with suitable fastenings is provided with each generator.

The alignment of the belt can be adjusted by loosening the guide and clamps on the cross bar and shifting the two outboard arms of the generator to one side or the other and then reclamping.

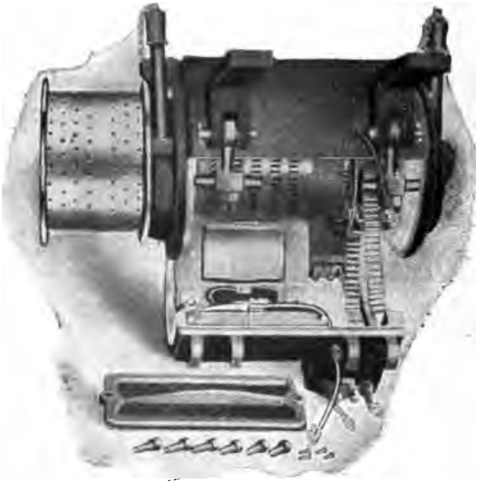


FIG. 80. SIDE VIEW OF GENERATOR SHOWING LOWER FRAME SWUNG DOWN, EXPOSING INTERNAL PARTS, ARMATURE REMAINING IN UPPER FRAME.

ADVANTAGES OF BLISS SUSPENSION.—The advantages of this form of suspension over all others are:

1. The generator being supported entirely by the upper portion, the lower portion is left free and clear for inspection and repairs; the lower half of the field frame, armature, bearings, pulleys and all other parts can be emoved without disturbing the supporting framework.

2. The adjustment of the belt tension is effected by means of a direct longitudinal movement of the generator, which is the universal practice with all stationary belt driven generators and motors, the roller bearings practically eliminating all sliding friction. The generator not being pivoted is not tipped or otherwise drawn out of its proper position in making wide adjustments of the belt tension.

3. The entire generator may be removed from the truck by removing the guides on the end sill and cross bar and unbolting the cross bar from the suspension bars.

4. The iron work is of the simplest possible design. There are no welds, and the amount of boring or other work on the truck frame is reduced to a minimum. One man and helper familiar with the work can install generator on truck in four hours.

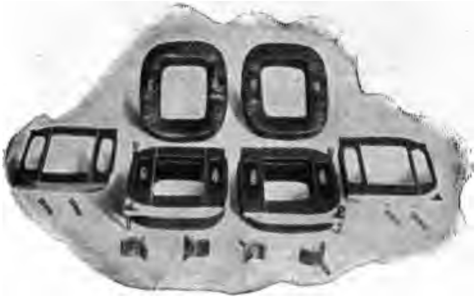


FIG. 81. GENERATOR FIELD COILS AND RETAINERS.

FIELD FRAME, MAGNETS AND BEARINGS.—All four forms of car generator are identical so far as the armature, field magnets and brush mechanism are concerned and these parts are all interchangeable. The generator proper is of the iron clad type, having four internal radia salient poles. The poles are placed at an angle of 45° with the horizontal, two poles being in the upper, and two in the lower half of the generator, which is divided longitudinally in a horizontal plane. The casing, which forms the yoke of the fields, is extended parallel with the axis of the shaft and is then turned in at right angles, thus forming ends which are bored out and have fitted into them round head-like castings which hold the armature shaft bearings and oil wells. This construction was originated by the Bliss Company. When these heads are in place, the generator is almost hermetically sealed, and is absolutely dust and water proof. A suitable hand-hole is provided in the generator casing for purposes of inspection, etc.

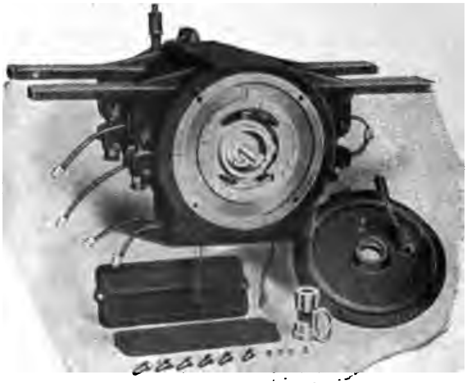


FIG. 82. END VIEW OF GENERATOR, SHOWING BEARING HEAD AND HAND HOLE COVER REMOVED, EXPOSING AUTOMATIC BRUSH MECHANISM.

The two heads which carry the armature bearings are *each held in* place by four bolts, two of which are tapped into each half of the generator casing. By this construction, the lower half of the generator may be removed, leaving the armature in the upper half, or the armature may be removed with the lower half. The heads being nicely fitted to the casing, insure perfect alignment of the armature shaft, no steady pins or other truing devices being required.

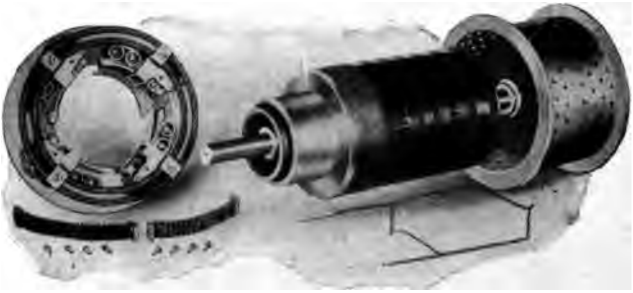


FIG. 83. COMPLETE GENERATOR ARMATURE AND PULLEY, AUTOMATIC BRUSH MECHANISM AND ARMATURE COIL.

By removing the head casting at the commutator end of the generator, and detaching the flexible cables from their respective brush-holders, the entire brush mechanism, as well as the armature, may be removed without disturbing any of the other parts.

ARMATURE.—The armature is of the four-pole drum type, having a two-circuit singly re-entrant drum winding of the straight-out, or barrel type. The coils are wound on formers and afterward placed on the core, thus providing a perfectly balanced winding, both electrically and mechanically.

The armature coils are assembled on the armature in the usual manner and specially banded. With this con struction, it is possible to remove a single damaged coil by simply lifting out one-quarter of the coils, when the damaged coil can be replaced by a new one. While this feature is extremely valuable in facilitating repairs, and has been adopted for this reason, we have no record of the burn-out of a generator armature.

SPIDER AND REMOVABLE SHAFT.—The core of the armature consists of the usual annular stampings, slotted to receive the coils, and mounted on a ventilated spider.

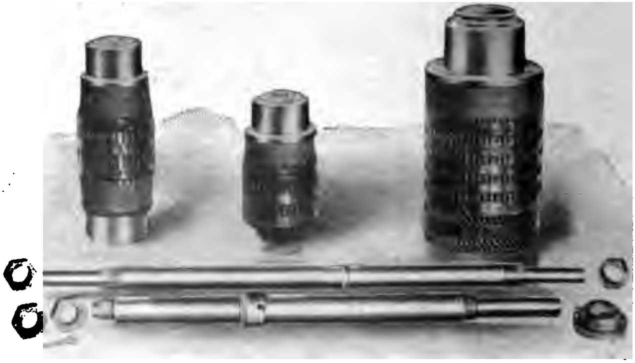


FIG. 84. ARMATURE SHAFTS AND NUTS OF GENERATOR AND BUCKER, SHOWING SPIDER AND REMOVABLE SHAFT CONSTRUCTION.

The central portion of the spider forms a sleeve which is extended at one end to support the commutator. The sleeve is bored to take the armature shaft, which is suitably keyed and otherwise secured. This construction is unusual in work of this capacity, and is only found in car lighting apparatus of our manufacture, and although entailing greater expense in construction, has been adopted on account of its value from an operating standpoint.

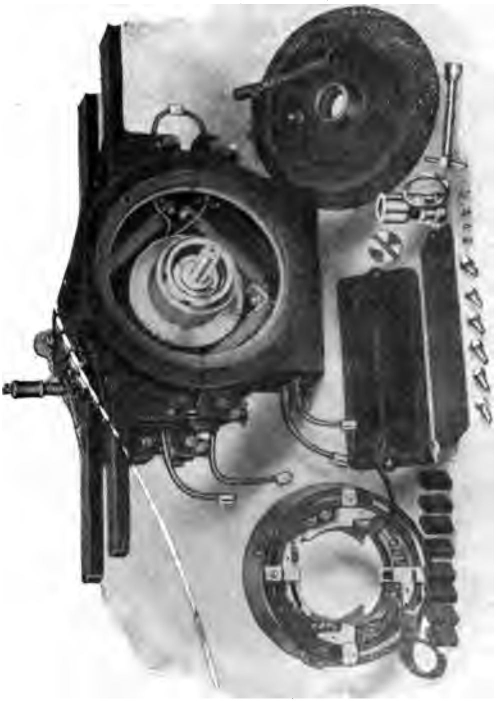


FIG. 85. END VIEW OF GENERATOR SHOWING BEARING HEAD AND HAND HOLE COVER REMOVED. EXPOSING ARMATURE, COMMUTATOR, BRUSH MECHANISM AND FIELD COILS.

This arrangement permits the armature and commutator to be quickly taken off the shaft without disturbing the windings, thus affording a ready means for making *repairs, either* to the shaft or to the armature itself.

JOURNALS AND LUBRICATION.—The armature shaft is extremely large for a machine of this capacity, and is manufactured from a fine grade of high carbon steel. The journals are unusually ample in their proportions, the commutator end bearing being 1¼"x4", the pinion end bearing 1½"x4½".

The lubrication is entirely automatic, and is effected by oil rings operating in oil wells of unusual capacity. All the running parts are heavily proportioned and are designed to resist the heaviest shocks and stresses. The generator is connected as a plain shunt wound machine and is self-exciting. Hence, there is but a single winding on the field, each pole being excited by a single coil, which is held in place by a special clamping device of extremely heavy construction.

BRUSHES.—The armature winding, being of the two-circuit type, requires but a single pair of brushes to take the current from the commutator, but, for purposes hereinafter explained, two pairs of brushes are employed.

CAPACITY AND RATING.—The generator is nominally rated at 4 kilowatts, 80 volts and 50 amperes or 40 volts and 100 amperes, this being its normal *continuous* safe load. The 50 ampere generator, however, has been successfully operated at 90 amperes for five hours without undue rise in temperature. Few cars can possibly utilize such a large output to advantage.

BRUSH MECHANISM AND AUTOMATIC POLE CHANGER. —The polarity of the terminals of the generator is preserved in the following manner: The brush-holders are mounted on a carrier, which is supported on anti-friction bearings, which enable it to rotate freely within the casing of the generator. The friction between the brushes and the commutator is sufficient to cause the brushes, and with them the carrier, to be dragged around as the commutator revolves. The angular motion of the carrier is arrested by means of a removable stop.

When the armature revolves in a right-hand direction, the brushes and carrier are rotated to the right and arrested by the stop in the correct position for commutation, and vice versa. It is obvious that the rotation of the armature having been reversed, and also the position of the brushes, the actual polarity of the generator terminals is preserved. It will be apparent that the angular motion of the brush carrier need be but 90° in a four-pole generator. The motion however is made a few degrees greater than a quadrant, thus providing a certain lead which aids commutation. Lead is impossible with any other type of pole changer.

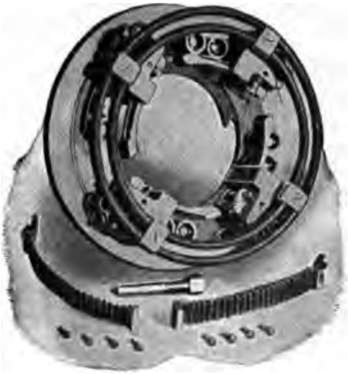


FIG. 86. AUTOMATIC BRUSH MECHANISM AND FLEXIBLE CABLES.

A single pair of brushes would suffice to take the current from the commutator, but by using four brushes, o two pairs, a short commutator is possible, a more symmetrical disposition of the brushes is secured, and adequate contact between the brushes and the commutator is obtained, without undue pressure on a single brush. The brushes of similar polarity are connected together in the usual manner, while flexible cables, readily detachable, convey the current from the brushes to the stationary terminals of the generator.

The preservation of the polarity of the brushes is thus secured mechanically, and without resort to contacts, switch-blades or other devices, which break or interfere with the continuity of the circuit. The friction between the brushes and the commutator cannot be avoided, and in the Bliss System is utilized to advantage.

The stop which arrests the motion of the carrier is removable, in order that, for inspection purposes and the renewal of brushes, the carrier may be turned completely around, and all the brushes and holders brought opposite the hand-hole in the generator casing.

BUCKER— TYPE. B.

Provided with Coupler.

The bucker is the distinctive feature of the Bliss System, and was devised for both regulating an axle generator and maintaining constant lamp voltage in connection with a generator and storage battery. It is a separate auxiliary and self-contained machine, which is bolted to the bottom of the car in any convenient place. This machine contains a revolving shaft, on which are mounted two armature cores. One of these armatures, with its commutator and field, constitutes a plain shunt motor which takes its power from the generator mains, and whose sole function is to rotate the shaft. It is obvious that this motor runs only when the generator is in operation.

The other armature has two windings and two commutators, and revolves in a field excited by the current flowing through the battery. This doublewound armature; with its two commutators and field, constitutes the "bucker" proper. The motor simply drives it. The winding connected in the lamp circuit is called the "lamp bucker," and the winding connected in the field circuit of the generator the "field bucker." The field of the bucker is referred to as the "series field;" that of the motor as the "motor field."

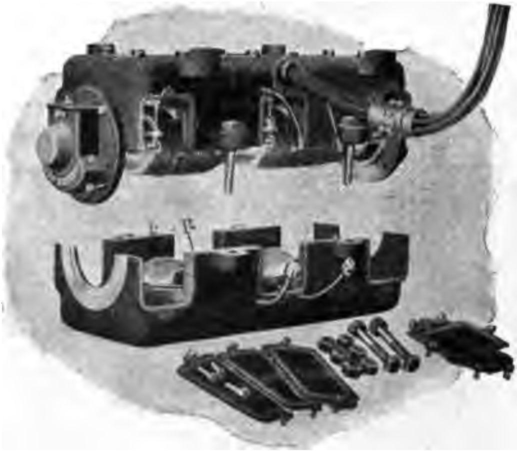


FIG. 87. BUCKER WITH LOWER FRAME REMOVED SHOWING ARMATURE IN UPPER FRAME.

As will be seen, by referring to illustrations, the bucker *is entirely* enclosed and hence is dust and water proof.

is impossible for anyone to tamper with it, and it contains no delicate or complicated parts.

ARMATURES.—The motor and bucker armatures are drum-wound for bipolar fields. They are built up of slotted annular punchings, and mounted, together with their commutators, on a sleeve which is fitted and keyed to the shaft. The construction is very similar to, and possesses all the advantages of that employed in the generator armature previously described. There is no pulley or external mechanical connection on this machine.

FIG. 88. COMPLETE BUCKER ARMATURE AND SHAFT.

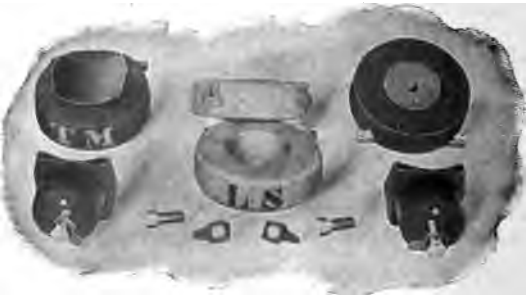


FIG. 89. BUCKER FIELD COILS AND POLE PIECES.

FIELD MAGNETS.—The field is of the bipolar, iron clad type. Each armature core revolves between two salient *pole pieces,* which are bolted into the casing, and consist of a *pole shoe* and core. Upon each core is placed a heavily taped and painted coil. The pole pieces are placed in a vertical line, so that one pole and coil for each armature core is in the upper, and one in the lower part of the machine.

Brush Holders.—The brush holders are mounted rigidly in the upper half of the machine. The springs and fingers are interchangeable with those of the generator. In taking off the bottom half of the casing, or in removing the armature, no wire connections need be disturbed beyond disconnecting the upper and lower field leads.

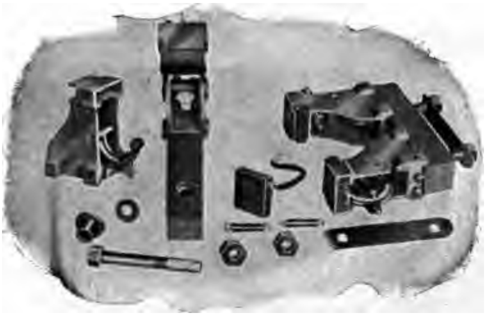


FIG. 90 BUCKER BRUSH HOLDERS AND DETAILS.

Bearings.—The head castings, containing the armature shaft bearings, are secured to the casing by four bolts, thus permitting the lowering of the bottom half of the casing with or without the armature. The illustration shows the armature entirely removed, together with the head castings and armature shaft bearings. The separate parts of this machine are light enough to be easily handled, no jacks or lifting devices being necessary. By referring to the cuts, it will be seen that large hand hole covers are provided over each brush holder, thus affording, by their removal, easy access to all internal parts.

TERMINALS AND CONNECTIONS.—The wiring of the bucker is entirely inside the casing. All of the leads (six in number) are brought out through a single opening provided with proper outlet bushing. These leads terminate in a coupler head carrying six terminal sockets, each provided with two binding screws. A corresponding coupler block is furnished with each bucker, in which the six leads of the car wiring are secured. Ferrules are provided, which are soldered over the ends of the car wires, after the insulation has been removed, and the *wires threaded* through the coupler block. One of the *ferrules is larger* in diameter than the others, as is also

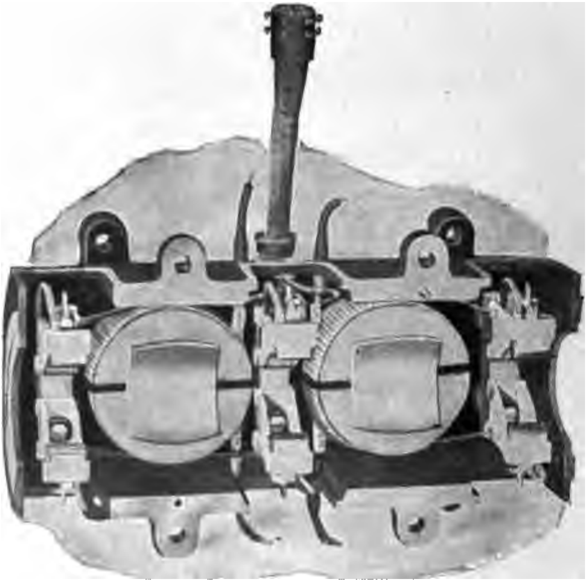


FIG. 91. INTERIOR VIEW OF BUCKER SHOWING CONSTRUCTION OF UPPER FRAME, BRUSH HOLDERS AND WIRING.

the hole in the corresponding terminal socket, thus providing a registering device which automatically insures the correct connection of the bucker to the car wires. The advantages of this construction are simplicity in installation, elimination of mutilated wire ends, and certainty of correct connections.

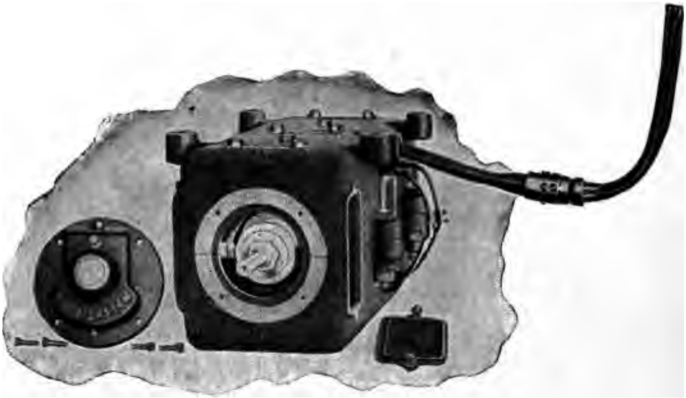


FIG. 92. END VIEW OF BUCKER SHOWING COMPLETE COUPLER HEAD AND BLOCK AND METHOD OF CONNECTING CAR WIRES. BEARING HEAD AND HAND HOLE COVER REMOVED EXPOSING MOTOR COMMUTATOR.

Operation of the Bucker.—It is obvious that when no current flows through the battery, none flows through the series field, since they are in series with one another, and hence no electro-motive-force is generated in the bucker; but when current flows through this series field, electro-motive-forces are generated in the bucker, and in almost exact proportion to the strength of the field. (After the closing of the automatic generator switch, the motor runs at almost constant speed, its slight acceleration as the generator voltage rises from normal lam voltage to maximum being an advantage, as it compensates for the drooping curve of magnetization in the series field.)

No current will flow through the series field under the following conditions:

1. When the generator is inoperative, automatic generator switch open, and no lamps lighted; for example, car standing still in day-time.

2. When the generator is operative, automatic generator switch closed, no lamps lighted and the generator voltage equal to the battery voltage; for example, running at cutting-in speed in day-time.

3. When the generator is operative, automatic generator switch closed, lamps lighted, and generator just carrying the lamp load, batteries neither charging nor discharging.

Under these three conditions, no regulation of generator or lamps is necessary.

Only one condition obtains when regulation is necessary, and that is:

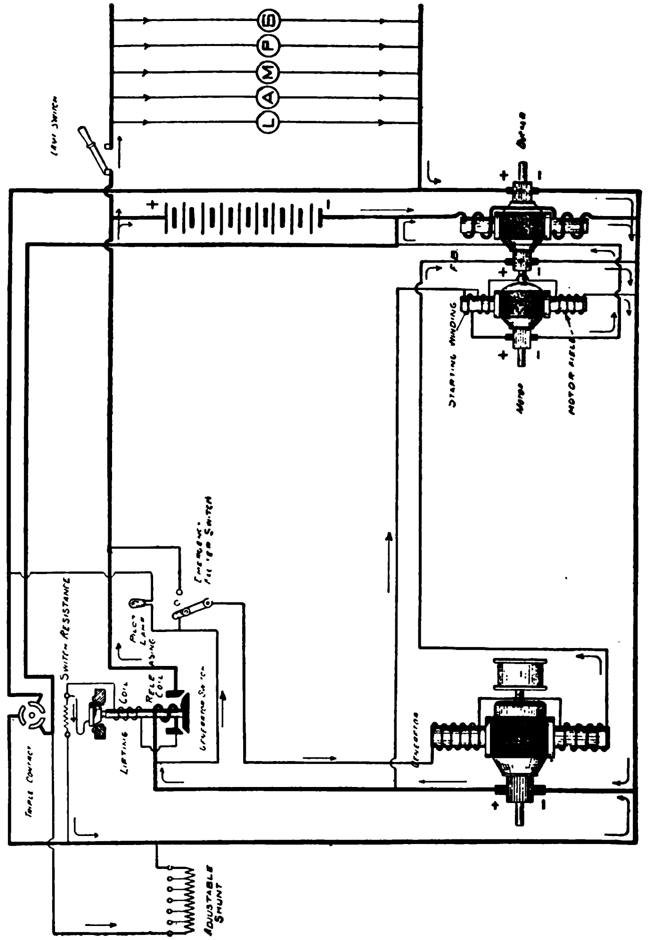
4. When the generator speed and voltage have risen and the battery is being charged; for example, running above operating speed, day or night. Then the voltage at the lamps tends to rise, and it must be kept constant, whether the lamps are lighted or not.

CONSTANT LAMP VOLTAGE.—The voltage at the terminals of the battery rises approximately in proportion to the current forced through them. The magnetism of the series field increases in proportion to this current. The counter voltages of the bucker increase in proportion to its field magnetism. Hence, the counter voltages of the *bucker increase* in proportion to the rise of electro-motive-force at the battery terminals. The lamp bucker, which is in the lamp circuit, will, therefore, produce a counter voltage always equal to the excess electro-motive-force necessary to impress on the batteries to charge them. The result will be a constant lamp voltage, independent of the number of lamps in use, or the speed of the train, since the latter now affects the charging current only.

Regulation of the Generator.—The field bucker is connected inversely in series with the field of the generator, and generates a counter voltage which weakens the field of the latter to such a degree that the voltage of the generator is just sufficient at the maximum train speed to force the maximum predetermined current through the battery and series field. The regulation tends to maintain constant current through the battery and series field at a given train speed. The lamp load is carried by the generator precisely as in the case of a constant potential machine and does not affect the charging current flowing through the battery.

Economy of the Bucker.—Since the bucker receives or absorbs energy from the lamp circuit and the field circuit of the generator, such energy is transformed into mechanical power and tends to revolve the shaft and thus relieve the motor of that work. In fact, when the apparatus is fully loaded, the motor becomes a generator and puts back into the system about 60% of the energy consumed by the bucker in effecting regulation.

Generator Switch.—It is necessary to provide an automatic switch which will complete the circuit between the generator and the storage battery whenever the speed of the former and consequently its voltage, is equal to or greater than that of the battery. On the other hand, this switch must likewise break that circuit whenever the



Complete Theoretical Wiring Diagram

FIG. 93. COMPLETE THEORETICAL WIRING DIAGRAM.

voltage of the generator is less than that of the storage battery, by virtue of a reduced or zero speed. The automatic generator switch opens and closes the circuit between the generator and the storage battery electrically, and is closed directly by the generator voltage.

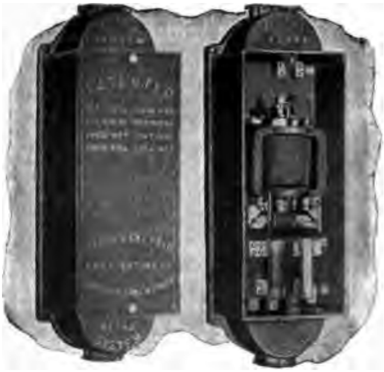


FIG. 94. GENERATOR SWITCH IN SINGLE SECTION IRON BOX.

CONSTRUCTION.—The generator switch consists of a rectangular iron frame, which forms the magnetic circuit of a solenoid and supports the insulated contacts. Within the frame are two concentric coils, constituting the solenoid. They are made entirely separate, to facilitate construction and repairs, and are held in place by a central tube. The inside, or lifting coil, is wound with fine wire, and is connected across the terminals of the generator. The outside, or releasing coil, is edgewise wound out of copper bar, and connected in series with the generator and storage battery. Within the central tube, and free to work in a vertical direction, is a soft iron plunger, attached to and insulated from a laminated metal brush.

OPERATION.—When the generator develops normal lamp voltage the switch will close, as the fine wire, or lifting coil, raises the plunger and causes the metal brush to make connection between the two metallic contacts. As the speed and generator voltage increase, current will flow through the contacts, brush and releasing coil, and through the battery, the releasing coil being wound in such a direction that this current aids the lifting coil in holding up the plunger and brush, maintaining a better contact for increasing current.

When, however, the voltage of the generator becomes less than that of the battery, current will flow from the battery in a reverse direction, through the releasing coil and generator, and oppose the action of the lifting coil. The weight of the plunger and brush is then sufficient to cause the opening of the switch by gravity. No springs are used to secure the adjustment, which is made by varying the length of the air-gap, and when once made is permanent. Renewable carbon contacts, on which the final break takes place, protect the metallic parts against injury by arcing.

TRIPLE CONTACT.—Upon the top of the iron frame of the automatic generator switch is mounted a triple contact, consisting of a three-part segmental socket and a conical plug fitting the same. The function of the triple contact is to short-circuit the lamp bucker and series field, thus avoiding the drop that would otherwise take place in the lamp circuit when the battery was discharging, and to render the bucker inoperative below operating speeds, when the generator switch is open.

The plug is raised and lowered by means of a tail-rod attached to the plunger of the switch. When the plunger is down and the generator switch open, the plug connects the three segments together. When the plunger and plug are raised by the lifting coil, the triple contact is broken. The plug is insulated from the tail-rod and a flexible conductor permanently connects the plug with an insulated terminal, mounted on a tarnsite base.

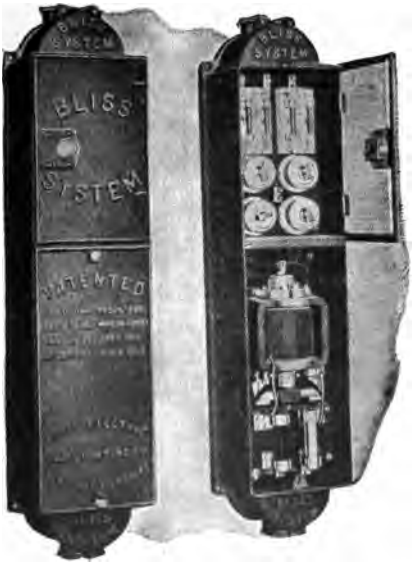


FIG. 95. GENERATOR SWITCH WITH FOUR-CIRCUIT PANEL BOARD IN DOUBLE SECTION IRON BOX.

One lead of a resistance coil is connected to this insulated terminal, and the other lead is connected to the rear segment of the triple contact. The negative lead of the generator is also connected to this segment. The leads of the lifting coil are connected, respectively, to the positive main contact, and the terminal to which the flexible conductor is attached. Thus it will be seen that when the plug establishes the triple contact it also short-circuits the resistance coil. When the plug is raised, it throws the resistance into series with the lifting coil.

Two advantages result from inserting resistance into the lifting coil circuit: First, to reduce the current and consequent heating in the coil, which would otherwise change its resistance and alter the adjustment of the switch; second, to reduce the magnetizing effect of the coil, so that less discharge current will be required in the releasing coil to open the switch, as above explained.

FUSE DECK.—The generator switch is mounted on a tarnsite base and enclosed in an iron box provided at top and bottom with suitable conduit fittings. On the lower part of the base is mounted the fuse deck, which supports all the positive terminals, the negative terminals being on the base below and back of the fuse deck. As the name implies, the fuse deck also carries the fuses for the generator and battery. By the removal of these fuses, and the insertion of a special ammeter connection, readings of current can be quickly and easily made without the use of tools and the attendant danger of short circuit.

ADJUSTABLE SHUNT.—In order to adjust the charging current delivered by the generator to the storage battery, an adjustable shunt is provided which consists of a number of steps of resistance enclosed in a small cast iron case which is mounted inside the car and as near the switch box as convenient. This shunt is connected across the terminals of the series field of the bucker and serves to divert a certain portion of the charging current from said field. A number of binding posts are provided on the shunt so that its resistance may be varied, which is done by shifting one connecting wire from post to post until the proper adjustment has been secured and then the wire is made permanently fast. This shunt acts exactly like the shunt on the series field of a compound generator. It affords a simple and easy method of adjustment and by its use the charging current can be varied about 100%.

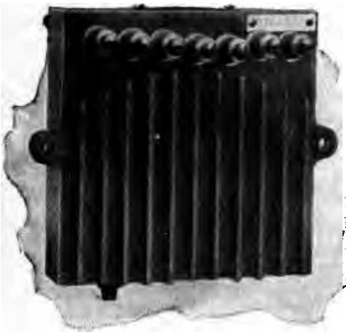


FIG. 96. ADJUSTABLE SHUNT.

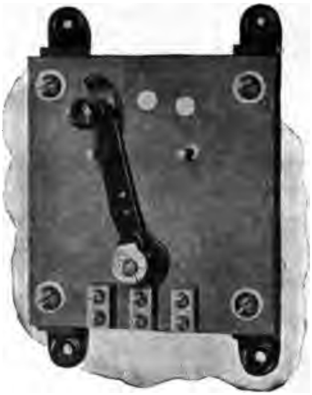


FIG. 97. EMERGENCY EXCITER SWITCH.

EMERGENCY EXCITER SWITCH.—This switch consisting of a spring actuated lever turning upon two contact buttons, provides a quick and certain method of exciting the field of the generator directly from the storage battery in case of loss of residual magnetism or any other cause preventing the generator from "picking up." Ordinarily the field circuit is completed through this switch so that the generator is self-exciting, but by throwing the lever to the right, the field is connected directly to the battery, and of course excited. Upon letting go of the lever, the spring restores the original connection. This switch may be shifted while the apparatus is at rest or in motion and its manipulation will not affect the apparatus in the slightest.

Junction Box.—To facilitate and simplify the wiri of the apparatus, a cast iron junction box has been pr vided, into which all the wires from the different piec of apparatus are led. This box is secured to the botto of the car body in any convenient location, and if possibl should be installed about six inches from the edge the car body, and as near the generator as proper clea ance will permit.

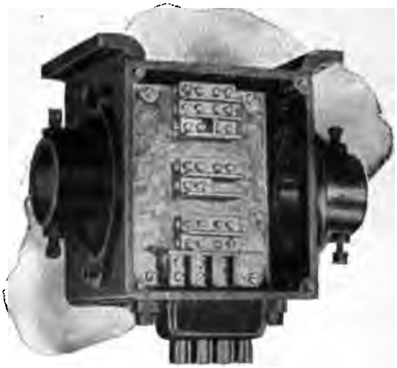


FIG. 98. FRONT VIEW JUNCTION BOX, WITH COVER REMOVE

The two side openings are designed to receive tw inch iron pipe or conduit, which should be used for e closing and protecting all of the wiring on the bottom the car. On the underside of the junction box is a fittin into which are fastened four insulating bushings for t reception of the four wires which lead to the generato By properly securing these wires into the bushings, t fitting may be removed bodily from the bottom of t junction box, whenever it is necessary to remove the c *truck. This* renders it certain that the wires will *properly* replaced when the generator is reconnected.

CODE OF RULES

GOVERNING THE CONDITION OF, AND REPAIRS TO, FREIGHT CARS

FOR THE

INTERCHANGE OF TRAFFIC

ADOPTED BY THE

MASTER CAR BUILDERS' ASSOCIATION

REVISED AT
ATLANTIC CITY, N. J., JUNE, 1908.

CODE OF RULES.

Governing the Condition of, and Repairs to, Freight Cars for the Interchange of Traffic.

PREFACE.

These rules make car owners responsible for, and therefore chargeable with, the repairs to their cars necessitated by ordinary wear and tear in fair service, so that defect cards will not be required for any defects thus arising.

Railroad companies handling cars are responsible for damage done to any car by unfair usage, derailment or accident, and for improper repairs made by them, and they should make proper repairs at their own expense, or issue defect card covering all such damage or improper repairs.

All inspection of freight cars for interchange will be made in accordance with the following rules:

CARE OF FOREIGN FREIGHT CARS.

RULE I. Each railway company shall give to foreign cars, while on its line, the same care as to oiling, packing, inspection and adjusting brakes, that it gives to its own cars.

INTERCHANGING FREIGHT CARS.

RULE 2. Cars offered in interchange must be accepted if in safe and serviceable condition, the receiving road to be the judge in cases not provided for in Rules 3 to 56, inclusive.

In case cars are rejected by the receiving road and returned to the delivering company, all the defects objected to must be designated on a return card 3½ by 8 inches of the following form, filled in with ink or black indelible pencil, and placed on the car adjacent to the destination card:

RETURN CARD

………………………Car No.………………………

from………………………………………………Ry.,

to…………………………………………………Ry.

for the following defects………………………………

……………………………………………………………

……………………………………………………………

……………………………………………………………

……………………………………………………………

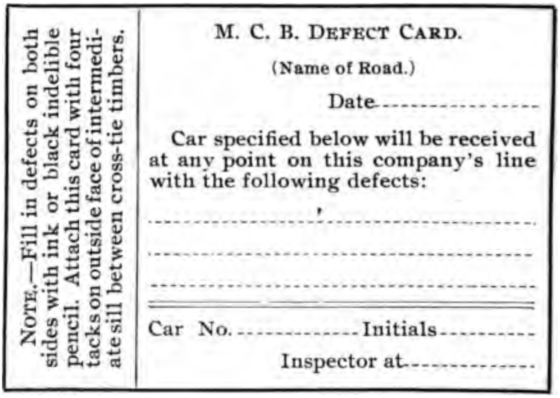
……………………………………

Inspector.

INSTRUCTIONS FOR INSPECTORS.

USE OF DEFECT CARD.

RULE 3. Defect cards shall be 3½ inches by 8 inches, and of the form shown below. They should be printed in red ink on both sides, and shall be filled in on both sides *with ink* or black indelible pencil. The cards must plainly specify in full each item for which charges are authorized, indicating on which end of the car the defects exist. The end of the car upon which the brake staff is located shall be known as "B" end, and the opposite end shall be known as "A" end. Where there are two brake staffs on same car, the end toward which the cylinder push rod travels shall be known as "B" end.



NOTE.—Fill in defects on both sides with ink or black indelible pencil. Attach this card with four tacks on outside face of intermediate sill between cross-tie timbers.

M. C. B. DEFECT CARD.

(Name of Road.)

Date..................

Car specified below will be received at any point on this company's line with the following defects:

....

....

....

Car No. .... Initials.............

Inspector at..............

RULE 4. Defect cards shall not be required for defects for which owners are responsible, except for missing material on cars offered in interchange, as provided for in Rules 27, 32, 35 and 42, neither shall they be required of the delivering road for improper repairs that were not made by it, with the exception of the cases provided for in Rules 29, 34, 43, 44 and 45.

RULE 5. If a car has defects for which the owners are not responsible, but which do not render it unsafe to run, nor unsafe to trainmen, nor to any lading suitable to the car, the receiving road may require that a defect card be securely attached to the car with four tacks, preferably on the outside face of intermediate sill, between cross-tie timbers, on wooden cars; and on steel cars to cardboard located either on cross-tie under car or on inside of side sill at the end of car.

RULE 6. Duplicate defect cards shall be furnished for lost or illegible cards.

Wheels.

DEFECTS OF WHEELS WHICH JUSTIFY RENEWAL.

RULE 7. Shelled out: wheels with defective treads on account of pieces shelling out; if the spots are over 2½ inches, or are so numerous as to endanger the safety of the wheel. Owners responsible.

RULE 8. Seams ½ inch long or over at a distance of ½ inch or less from the throat of the flange, or seams 3 or more inches long, if such seams are within the limits of 3¾ inches, as shown on Fig. 5. Owners responsible.

RULE 9. Worn through chill; when the worn spot exceeds 2½ inches in length. Care must be taken to distinguish this defect from flat spots caused by sliding wheels. Owners responsible.

RULE 10. Worn flange: cast wheels under cars of less than 80,000 pounds capacity, with flanges having flat vertical surfaces extending more than 1 inch from tread, or flange 15-16 inch thick or less, gauged at a point ⅜ inch above tread. Wheels under cars of 80,000 pounds capacity or over, with flanges having flat vertical surfaces extending more than ⅞ inch from tread, or flange less than 1 inch thick, gauged at a point ⅜ inch above tread (see Figs. 4 and 4a). Owners responsible.

Worn flange: steel and steel-tired wheels with flanges *having flat* vertical surfaces extending more than 1 inch from tread, or flange 15-16 inch thick or less (see Figs. 4 and 4a). Owners responsible.

RULE 11. Thick flange: flange over 1 7-16 inches thick for cast-iron wheels, standard of 1903, 1904, 1905 and 1906 (see Fig. 2), or flange over 1 11-32 inches thick for cast-iron wheels having increased flange and tread standard of 1907. (See Fig. 2 *a*.) Owners responsible.

RULE 12. Tread worn hollow: if the tread is worn sufficiently hollow to render the flange or rim liable to breakage. Owners responsible.

RULE 13. Burst: if the wheel is cracked from the wheel fit, outward, by pressure from the axle.

RULE 14. Cracked or broken flange, caused by seams, worn through chill or worn flange. See also Rules 20 and 21. Owners responsible.

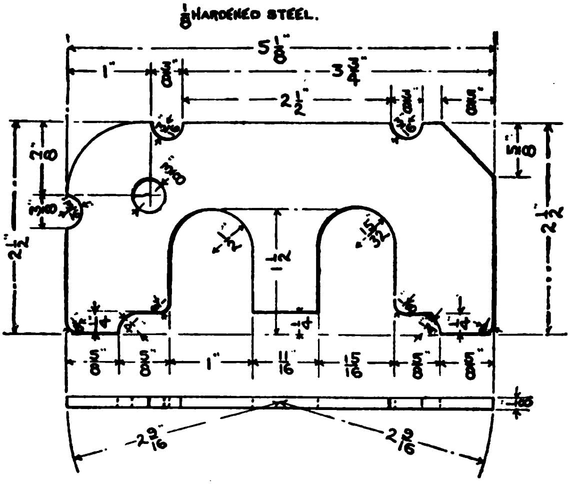
RULE 15. Broken or chipped rim, caused by defective casting, if the tread, measured from the flange at a point 5/8 inch above tread, is less than 3¾ inches in width. (See Fig. 5.) See also Rules 20 and 21. Owners responsible.

RULE 16. Cracked tread, cracked plate, one or more cracked brackets, or broken in pieces under fair usage. See also Rule 20. Owners responsible.

Steel or steel-tired wheels loose, broken or cracked hubs, plates, bolts, retaining ring or tire under fair usage. Owners responsible.

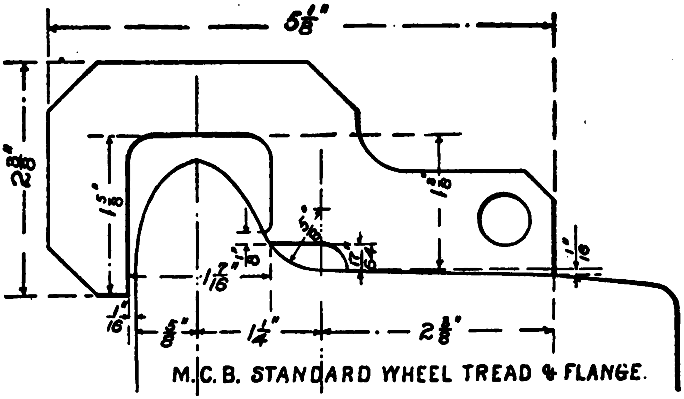
RULE 17. Wheels loose or out of gauge. (See Fig. 6.) Owners responsible.

RULE 18. Chipped flange; if chip is on the opposite side from throat of flange and exceeds 1½ inches in *length and ½* inch in width, or if it extends ⅛ inch past *the center of* flange. Owners responsible.



Wheel Defect and Worn Coupler Limit Gauge.

FIG. 1.

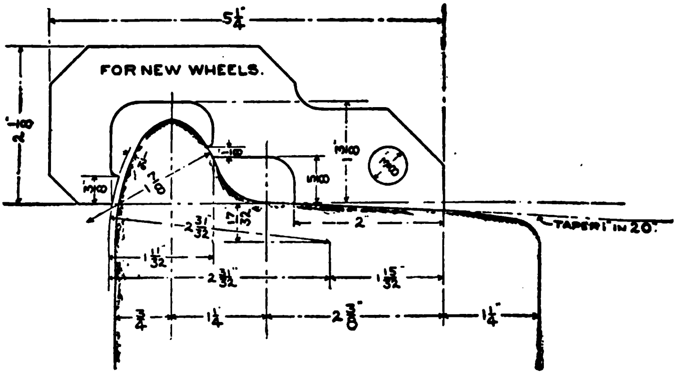


MAXIMUM FLANGE THICKNESS GAUGE.

FIG. 2.

RULE 19. Flat sliding: if the spot caused by sliding is 2½ inches or over in length. (Care should be taken to distinguish this defect from *worn through chill.*) Delivering Company responsible.

RULE 20. Broken flange, except as in Rule 14; chipped flange, if chip is on throat side of flange, and exceeds 1½ inches in length and ½ inch in width, or if it extends ⅛ inch past the center of flange; broken rim, if not caused by defective casting, if the tread, measured from the flange at a point ⅝ inch above tread, is less than 3¾ inches in width (see Fig. 5), or any breakage caused by unfair usage, derailment or accident. Delivering Company responsible.

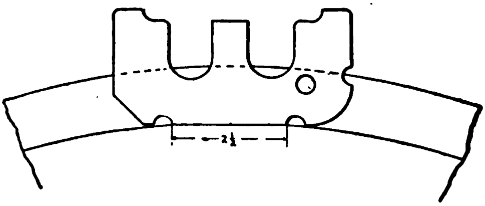


Maximum Flange Thickness Gauge.

FIG. 2-A.

RULE 21. The determination of flat spots, worn flanges and chipped treads shall be made by a gauge as shown in Fig. 1. The determination of thick flanges shall be *made by a gauge* as shown applied to M. C. B. standard *wheel tread* and flange in Figs. 2 and 2a.

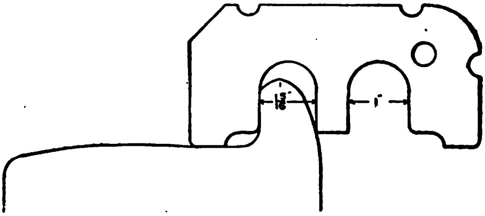
The following engravings of the wheel defect gauge, Fig. 1, show the method of using it:



METHOD OF GAUGING SHELLED AND FLAT SPOTS

FIG. 3.

SEE RULES 7 AND 19.

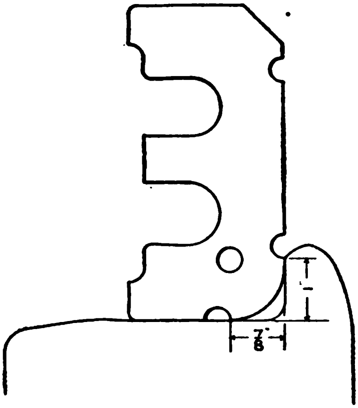


METHOD OF GAUGING WORN FLANGES

FIG. 4.

SEE RULE 10.

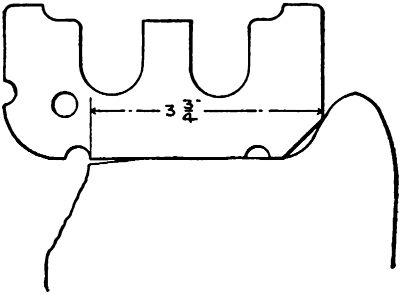
For wheels under cars of less than 80,000 pounds' capacity, and steel or steel-tired wheels with flanges 15-16 inch thick or less; 80,000 pounds capacity or over, with flanges less than 1 inch thick.



Method of Gauging Worn Flanges.
FIG. 4 *a*.

SEE RULE 10.

For wheels under cars of less than 80,000 pounds' capacity, and steel or steel-tired wheels 1 inch from tread; 80,000 pounds' capacity or over, 7/8 inch from tread.



Method of Gauging Chipped Rims.

FIG. 5.

SEE RULES 15 AND 20.

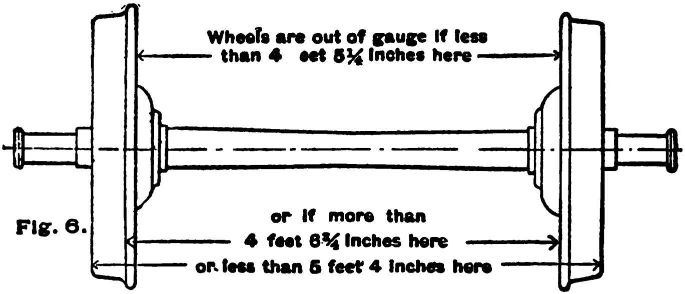

Wheels are out of gauge if less than 4 feet 5¼ inches here
or if more than 4 feet 6¾ inches here
or less than 5 feet 4 inches here

Fig. 6.

Measurements to be made at the same height on the wheels as the Center of the Axle.

For wheels cast prior to the M. C. B. standard tread and flange adopted in 1907.

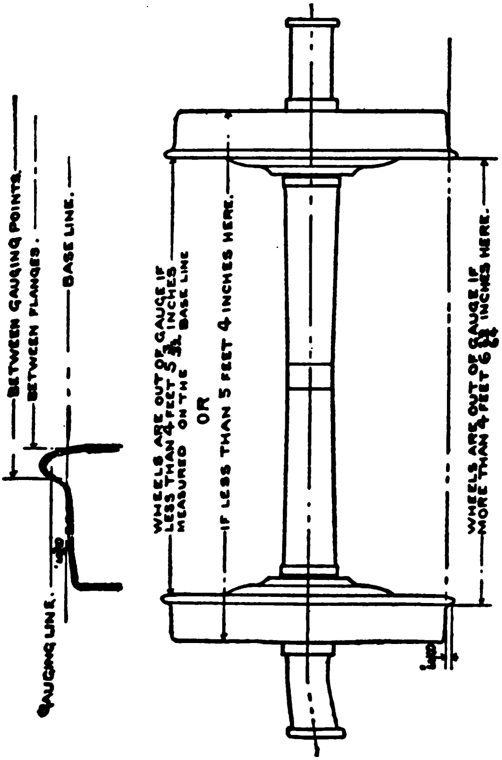

BETWEEN GAUGING POINTS.
BETWEEN FLANGES.
BASE LINE.
GAUGING LINE.
WHEELS ARE OUT OF GAUGE IF LESS THAN 4 FEET 5 3/32 INCHES MEASURED ON THE BASE LINE
OR
IF LESS THAN 5 FEET 4 INCHES HERE.
WHEELS ARE OUT OF GAUGE IF MORE THAN 4 FEET 6 11/64 INCHES HERE.

Fig. 6-A.

Measurements to be made at same height on the wheels
the center of the axle.
as For wheels cast after January 1, 1908.

AXLES.

AXLES WHICH JUSTIFY RENEWAL.

RULE 22. Axles broken or having seamy or pitted journals, fillets in back shoulder worn out, or collars broken off or worn to ¼ inch or less under fair usage. Owners responsible.

RULE 23. Axles less than the following prescribed limits:

FOR CARS MARKED WITH "CAPACITY."

CAPACITY OF CAR.	JOURNAL.	WHEEL SEAT.	CENTER.
100,000	5 inches.	6¾ inches	5⅞ inches.
80,000	4½ "	6¼ "	5 5/16 "
70,000	4 "	5⅝ "	4⅞ "
60,000	3¾ "	5 "	4⅜ "
50,000	3½ "	4¾ "	4⅛ "
40,000	3¼ "	4⅝ "	3⅞ "
30,000	3 "	4¼ "	3½ "

FOR CARS MARKED "MAXIMUM WEIGHT."

MAXIMUM WEIGHT	JOURNAL.	WHEEL SEAT.	CENTER.
161,000	5 inches.	6¾ inches.	5⅞ inches.
132,000	4½ "	6¼ "	5⅜ "
112,000	4¼ "	6 "	5¼ "
95,000	3¾ "	5½ "	4¾ "
79,000	3½ "	5¼ "	4⅝ "
66,000	3¼ "	4⅞ "	4¼ "
58,000	3 "	4¾ "	4⅛ "

All cars to have their light weight and capacity or their light weight and maximum weight stenciled on them. Owners responsible.

RULE 24. Cut journals, axles bent or axles rendered *unsafe* by unfair usage, derailment or accident. Delivering *Company* responsible.

TRUCKS.

PARTS OF TRUCKS WHICH JUSTIFY REPAIRS IF OWNERS ARE RESPONSIBLE, OR REPAIRS OR CARDING IF DELIVERING COMPANY IS RESPONSIBLE.

RULE 25. Defective, missing or worn-out parts of trucks not elsewhere provided for, which have failed under fair usage, or if any part of the truck frame or attachments is less than 2½ inches above the top of the rail. Owners responsible.

RULE 26. Damage of any kind to the truck due to unfair usage, derailment or accident. Delivering Company responsible.

RULE 27. Material missing from trucks of cars offered in interchange. Delivering Company responsible.

RULE 28. Journal bearings and journal box bolts which require renewal by reason of change of wheels or axles for which the delivering company is responsible, regardless of the previous condition of the bearings. Delivering Company responsible.

RULE 29. Cars equipped with steel or steel-tired wheels and so stenciled, if found with cast-iron wheels. Delivering Company responsible.

BRAKES.

PARTS OF BRAKES WHICH JUSTIFY REPAIRS.

RULE 30. Damage to interior portion of cylinder or triple valve, leaky pipes, account of seams, air hose burst from air pressure, torn air hose and defective missing or wornout parts of brakes not elsewhere provided for, which have failed under fair usage; except burst or torn air hose, burst or leaky pipes, account of seams, or missing material on cars offered in interchange. Owners responsible.

Rule 31. Cylinder or triple valves of air-brake cars not cleaned, oiled and tested within twelve months and the date of last cleaning, oiling and testing, preferably marked on the brake cylinder or auxiliary reservoir, or if same is not readily visible, in a convenient location at release rod, with white paint. Owners responsible.

Rule 32. If the car has air-signal or steam pipes the hose, pipes and couplings on the car are at owner's risk, unless the car is stenciled that it is so equipped. Owner's responsibility qualified.

Rule 33. Cars equipped with air-brake hose other than M. C. B. Standard and hose applied without swelled end and not conforming to M. C. B. standard hose on and after June 1, 1909 (owners responsible), except cars offered in interchange, where delivering company is responsible. Delivering Company responsible.

Rule 34. If 1-inch hose and fittings are found on 1¼-inch train pipe. Delivering Company responsible.

Rule 35. Missing air-brake hose, missing or damaged air-brake pipe, fittings, angle cocks, cut-out cocks, cylinders, reservoirs, triple valves, release valves, pressure-retaining valves or any parts of these items; also pressure-retaining valve and pipe when damage to car denotes rough usage. Delivering Company responsible.

Rule 36. Damage to any part of the brake apparatus caused by unfair usage, derailment or accident. Delivering Company responsible.

Rule 37. All freight cars offered in interchange must be equipped with air brakes. On and after September 1, 1909, M. C. B. standard 1¼-inch train line shall be *used.*

BODIES.

PARTS OF BODIES WHICH JUSTIFY REPAIRS IF OWNERS ARE RESPONSIBLE, OR REPAIRS OR CARDING IF DELIVERING COMPANY IS RESPONSIBLE.

RULE 38. Locks, side doors, end doors, roof doors, grain doors and all inside or concealed parts of cars missing or damaged under fair usage, and failure or loss under fair usage of any part of the body of the car, except as provided for in Rules 42 and 87.

All cars not originally equipped with retaining valves. Owners responsible.

RULE 39. Cars not within the limits of standard height for couplers, 31½ inches to 34½ inches for standard gauge cars. Owners responsible.

RULE 40. Steps, ladders, handholds, or running boards in bad order or insecurely fastened, or absence of grabirons or handholds as required by law. Handholds or grabirons must be of wrought iron or steel and secured by bolts, rivets or lag screws. Owners responsible.

RULE 41. Damage of any kind to the body of the car due to unfair usage, derailment or accident; also temporary advertisements tacked, glued, pasted or varnished on cars. Any card or poster which bears the name of a manufacturer or shipper printed on same will be considered as an advertisement. Delivering Company responsible.

RULE 42. Material missing from body of cars offered in interchange, except locks, grain doors and all inside or concealed parts of car. Delivering Company responsible.

RULE 43. M. C. B. couplers not equipped with steel or *wrought-iron* knuckles. Delivering Company responsible

RULE 44. Cars intended to be equipped with metal brake beams and so stenciled, if found with wooden brake beams. Delivering Company responsible.

RULE 45. Cars equipped with M. C. B. couplers having pocket rear-end attachments and so stenciled, if found with stem or spindle attachments instead of pocket. Delivering Company responsible.

RULE 46. Uncoupling attachments of M. C. B. couplers offered in interchange must be made operative before moving from interchange points. Delivering Company responsible.

IMPROPER REPAIRS.

RULE 47. Any company making improper repairs is solely responsible to the owners, with the exception of the cases provided for in Rules 29, 34, 43, 44, 45, 46, and also in case it should be necessary to replace stem or spindle with pocket attachment. Company making repairs responsible.

RULE 48. The company making such improper repairs shall place upon the car, at the time and place the work is done, an M. C. B. defect card, which card shall state the wrong material used. Company making repairs responsible.

COMBINATIONS OF DAMAGES WHICH DENOTE UNFAIR USAGE, IF OCCURRING AT THE SAME END OF CAR.

RULE 49. Damage to coupler, accompanied by damage to either combined front and back coupler stop, draft timber, or its substitute or end sill.

RULE 50. Damaged coupler pocket, accompanied by *damage to* either draft timber or its substitute, or end *sill.*

RULE 51. Damaged combined front and back coupler stop, accompanied by damage to either coupler or end sill.

RULE 52. Damaged draft timber or its substitute, accompanied by damage to either coupler, coupler pocket, or to end sill.

RULE 53. Damaged end sill, accompanied by damage to either coupler, coupler pocket, combined front and back coupler stop, draft timber or its substitute or longitudinal sill.

RULE 54. Damaged longitudinal sill, accompanied by damage to end sill.

RULE 55. Damaged longitudinal sills, if necessitating replacement or splicing of more than two sills.

RULE 56. Damaged corner and end posts, if necessitating the replacement of, or repairs to, more than two end or two corner posts at one end, or more than one end and one corner post at same end of car.

The word "coupler" in the above rules, 49 to 53, inclusive, means the coupler body or knuckle, open knuckles excepted.

An American continuous draft key and rod shall not enter into a combination of defects denoting unfair usage.

It will be assumed that a missing coupler and attachments are damaged unless shown to the contrary. This only refers to cases where the coupler if broken would enter into the combination of defects.

INSTRUCTIONS TO REPAIR MEN.

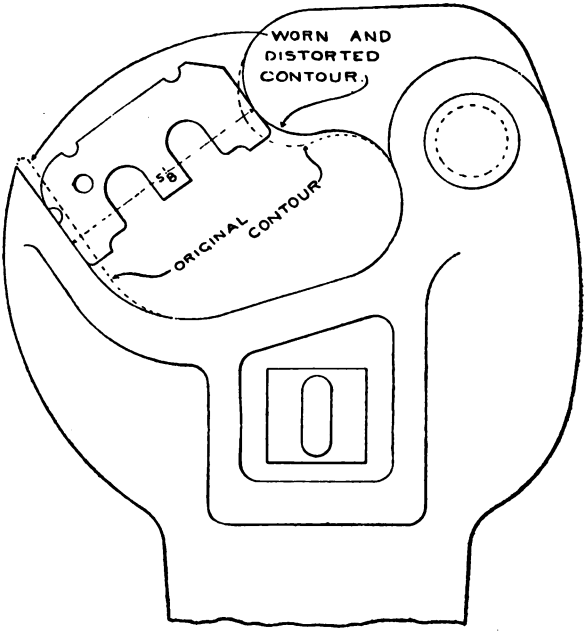
RULE 57. Any car having defects which render it unsafe to run, unsafe to trainmen, or to any lading suitable to the car; may be repaired.

RULE 58. Repairs to foreign cars shall be promptly made, and the work shall conform in detail to the original construction, and with the quality of material originally used, except as provided for in Rules 59 and 62. Malleable iron, M. C. B. standards, may be substituted for gray iron, M. C. B. standards, but the net cost to car owner in such cases must be no greater than if the original kind and weight of material had been applied. Gray iron, M. C. B. standards, may be substituted in place of malleable, M. C. B. standards, but in such cases the debits and credits must be for what is actually applied and removed. Repair cards and stubs must state kind of material applied and removed.

RULE 59. In repairing damaged cars M. C. B. standards may be used when of dimensions that do not impair the strength of the cars, in lieu of the parts forming its original construction. In making repairs, cast iron brake shoes may be replaced with reinforced brake shoes. When using materials for repairs to foreign cars for which the Master Car Builders' Association has adopted specifications as a standard, the materials must comply with the requirements of these specifications.

RULE 60. In making repairs for which owners are responsible, wheels other than 33-inch may be replaced with 33-inch wheels, if practicable. If changes are necessary in order to bring the car to the proper height, the cost of so doing shall also be chargeable to the car owner.

RULE 61. Couplers of the vertical plane type other than M. C. B. replaced with M. C. B. standard, the expense of alteration thus necessitated shall be chargeable to car owners. Couplers that exceed the distance of 5⅛ inches between point of knuckle and guard arm measured perpendicularly to guard arm must be repaired. *(See drawing.)*



Rule 62. When M. C. B. couplers of another make are placed upon a car, the uncoupling arrangements shall be made operative at the expense of the company making the repairs. Malleable iron couplers, open knuckles and malleable or steel backed filled journal bearings shall not be used in repairs of foreign cars.

Rule 63. When M. C. B. couplers, knuckles, metal brake beams, wheels or axles are replaced under conditions which make them chargeable to the owner, it must be plainly stated on the repair card and stub whether the material is new or secondhand.

The cards and stubs must state whether solid or filled *journal* bearings are applied or removed; also, length o bearing. In the case of couplers applied and removed, they shall state the make and kind of material in couplers and the size of shank. In the case of knuckles, they must state whether open or closed knuckles are removed and applied. In the case of brake shoes removed and applied, they shall state the kind of shoe.

RULE 64. Any company finding cars not within the limits of standard height for couplers may make repairs and charge to owners. Cars should be adjusted in height when empty, as far as possible, and in order to justify a bill for this work under the Rules of Interchange an empty car measuring 32½ inches or less should be adjusted to 34½ inches, or within ¼ inch thereof, and when it is necessary to alter a loaded car it should be adjusted to 33½ inches, or within ¼ inch thereof, or as nearly as possible to such height as will bring it to 34½ inches when the car is unloaded, the height to be measured from top of the rails to the center line of the coupler shank.

RULE 65. Draft timbers must not be spliced. All longitudinal sills may be spliced once, with the exception of center sills, which may be spliced at both ends. Not more than two adjacent sills may be spliced at the same end of car.

The splice may be located either side of body bolster, but the nearest point of any splice must not be within 12 inches of same, excepting center sills, which must be spliced between body bolster and cross tie timbers, and not within *24* inches of either.

Longitudinal sills other than center sills where less than 12 inches in depth, the plan shown in Fig. 8 is to be *followed.* When the sills are 12 inches or more in depth *he plan shown* in Fig. 9 is to be followed. When center sills are spliced the plan shown in Fig. 9a is to be followed.

The size of horizontal or cross bolts shown in Fig. 9a should be ⅝ inch.

Sills of foreign cars shall be spliced in accordance with the standard form of splice shown above. Cars delivered in interchange with the form of splice shown in Fig. 9-B will be acceptable.

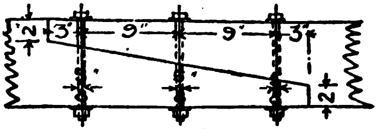


FIG. 8.

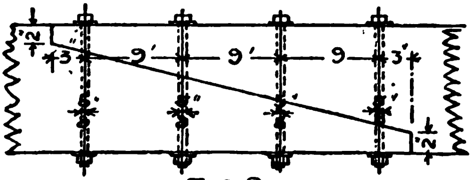


FIG. 9.

Steel sills may be spliced in the most convenient location in accordance with Figs. A B and C. Adjacent steel sills may be spliced.

RULE 66. Wheels on the same axle must be of the same circumference.

RULE 67. New wheels must not be mated with secondhand wheels.

RULE 68. Prick punching or shimming the wheel fit must not be allowed.

RULE 69. The wheel seats of foreign axles must not *be reduced* more than 1-16 inch to fit the wheels, and no case must they be reduced below the limits given in Rule 23.

RULE 70. Any company repairing foreign cars with wrong material, and not in compliance with the Rules

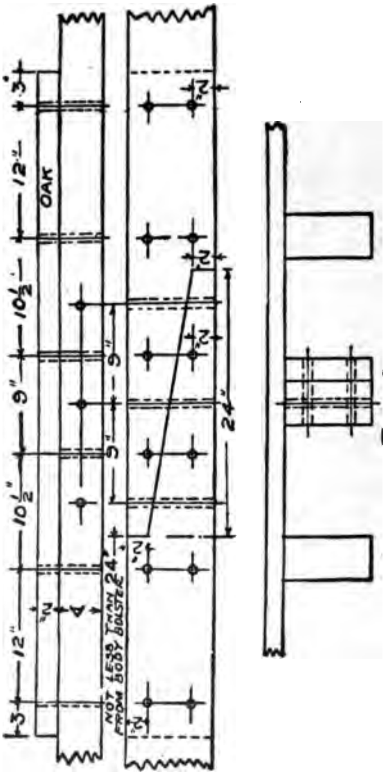


FIG. 9A.

The size of horizontal or cross bolts to be ⅝ inches.

57 to 70, inclusive, shall be liable to the owners for the cost of changing such car to the original standard, or to the requirements of these rules, except that companies pplying axles smaller than the limits given in Rule 2

shall not be held responsible for improper repairs if the car is not stenciled showing the capacity of the car.

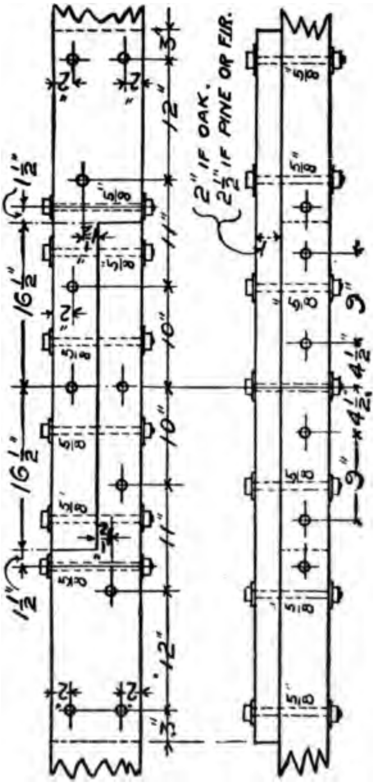


FIG. 9-B.

RULE 71. In replacing air-brake hose on foreign cars for which bills are made, new hose must be used.

Air-brake hose applied to foreign cars shall be considered wrong repairs unless they are made in accordance *with the* M. C. B. specifications and are so labeled.

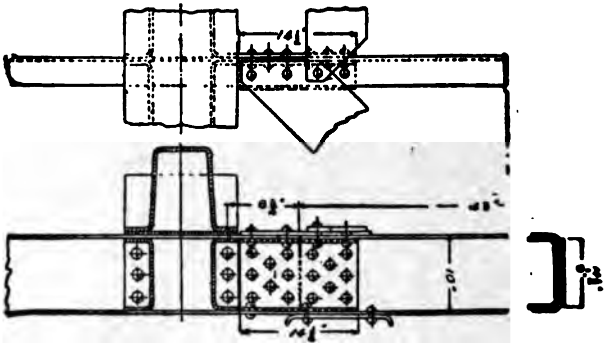


FIG. A.

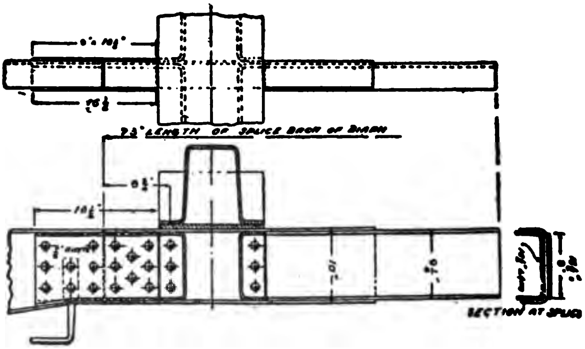


FIG. B.

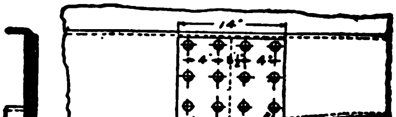


FIG. C.

RULE 72. If the weight of a car is found to vary more than 500 pounds from the light weight stenciled on the car, or if the light weight is obliterated, a railroad company having the car in its possession may weigh and restencil the car, making a charge for each car weighed and so reported. The railroad company making the bill shall notify the owner, giving the date and point at which the reweighing was done.

RULE 73. Cars undergoing extraordinary repairs, such as sills, resheathing, roofing, etc., must be reweighed and restenciled by the company having the car in its possession at its own expense, and the owner notified.

RULE 74. When secondhand axles are applied under conditions which make them chargeable to the owners, the diameters of the wheel seats and center must not be less than, and the diameter of the journal must be 1/8 inch greater than the limiting diameters given in Rule 23. If cars are marked with the word "Capacity," the first set of limits must be followed. If cars are marked "Maximum Weight," the second set of limits must be followed.

RULE 75. When two or more cars chained together, or any cars which require switch chains to handle them, are delivered at an interchange point, the receiving road shall deliver to the delivering road at the time, an equivalent number of switch chains of the same size as the chains so used on the cars delivered, or, in lieu thereof, furnish a defect card for such chains.

USE OF REPAIR CARD.

RULE 76. When repairs of any kind are made to foreign cars a repair card shall be securely attached to outside face of intermediate sill between cross-tie timbers on wooden cars, and on steel cars to cardboard located either on cross-tie under car or on inside of side sill at the end of car. This card shall specify fully the repairs made, and reason for same, the date and place where made, and name of road making repairs; also show location of parts repaired or renewed. The end of car on which brake staff is located shall be known as "B" end, and the opposite end as "A" end. Where there are two brake staffs on the car, the end toward which the cylinder push rod travels shall be known as "B" end. The card shall be provided with a stub, which will duplicate information on the card and stubs must be forwarded with the bill.

If no bill is to be rendered, the repair card stub must be forwarded on or before the twentieth day of each month, with the words "no bill" written across the face of the repair card stub. In case it is not the intention to render bill, the words "no bill" shall be written across the face of the repair card.

RULE 77. The repair card shall be 3½ by 8 inches, and the stub 3½ by 4 inches. The card shall be printed on both sides in black ink, and shall be filled in on both sides with ink or black indelible pencil, and be of the following form:

This Stub to be Retained by Person Issuing Card

Master Car Builders' Ass'n Repair Card Stub

C.M.&St.P.Ry Date____190—

Rep'd at ________ Shop

________ Inspector

Car No.____ Initials____

Reasons for repairs noted on other Side.

When Card is Applied send Stub at once to Supt. Motive Power, West Milwaukee, Wis.

Master Car Builders' Ass'n Repair Card Stub

C.M.&St.P Ry. Date____190—

Rep'd at ________ Shop

________ Inspector

Car No.____ Initials____

(OVER)

Reasons for repairs noted on other Side.

Form 617

Master Car Builders' Ass'n Repair Card

Chicago, Milwaukee & St. Paul Ry. Co.

Date__________190__

REPAIRS MADE	WHY MADE

Rep'd at________ Shop______ Inspector

Car No.________ Initials________

Note.—The printing on back of repair card stubs should be the reverse of that shown here.

RULE 78. Any road making partial repairs of defects on a car which are covered by defect cards will have the defects repaired crossed off the original card with ink or indelible pencil and card placed back on car. A copy of the card accompanying the bill with the defects which were not repaired crossed off will be sufficient authority to bill.

RULE 79. Duplicate repair cards shall be furnished for lost or illegible cards.

INSTRUCTIONS FOR BILLING.

RULE 80. Bills may be rendered for work done under Rule 57, except in cases where owners are not responsible and the car bears no defect card covering the defects repaired, stating upon the bill the date and place where the repairs were made; the repair card stub or defect card to accompany the bill.

RULE 81. Car owners may require receipt of repair card or stub before payment of bill for repairs.

RULE 82. For repairs made on defect cards, the card must accompany the bill as voucher for the work done, but no bill shall be rendered for repairs which have not been made.

RULE 83. When improper repairs of owner's defects have been made and bill rendered, the owner may counter-bill against the company making the wrong repairs for the cost of changing the car to the original standard, or to the requirements of Rules 57 to 79, inclusive, if the work is done.

RULE 84. When improper repairs of defects for which owners are not responsible are made, the owner may make bill against the company making the improper repairs for the cost of changing the car to the original standard, or to the requirements of Rules 57 to 79, inclusive, if the work is done.

RULE 85. The evidence of a joint inspector or the joint evidence of two persons, one representing the owner of the car, and the other representing the delivering road, that the repairs are not proper, shall be final. A joint evidence card shall be used for this purpose, which shall describe and show location of parts repaired or renewed. The end of the car on which the brake staff is located shall be known as "B" end, and the opposite end as "A" end. Where there are two brake staffs on the car, the end toward which the cylinder push rod travels shall be known as "B" end. This card shall be of the following form:

THE____________________RAILWAY CO.

REPORT OF IMPROPER REPAIRS TO__________CARS

Station________________________190___

Car No.________Initial________Received from________________Ry. At________________Date____________190___

Description of wrong Repairs__________	How Repairs should be made__________

Show how Carded on other Side.
We Certify Above to be Correct.

{ ________________________Inspector for__________Ry.
{ ________________________Inspector

THE..RAILWAY CO.

M. C. B. DEFECT CARD. Issued by............................Ry. At..........................Date........................190..

Inspector..............................Reading as follows..

....

....

....

....

....

M. C. B. REPAIR CARD. Issued by............................Ry. At..........................Date........................190..

Inspector..............................Reading as follows..

....

....

....

....

DISPOSITION OF CAR. Carded to..Shop; Repaired; went forward without Repairs, RULE 86. The joint evidence card, accompanied proper repair card, upon which a bill has been shall be used as authority for rendering bill, but accompanied by such repair card, the joint evidence shall be sent to the company against which the ev has been presented, and it shall furnish a defect card ering the wrong repairs if it made them.

RULE 87. Bills may be rendered against car o for the labor only of replacing couplers, brake (including their attachments, such as shoes, heads bolts, brake pins, jaws and hangers), brake levers, guides, top and bottom brake rods that have been lo the line of the company making the repairs. Co springs, followers and yokes may be included i above, providing they have been lost with the coupl

RULE 88. In making bills under these rules, th formation necessary for the car department shou embodied on the following forms, whether the sa made as a bill or a statement to accompany a bill:

................................Company,

Address..

To..Railroad Company, Dr.

For Wheels and Axles put under....................Cars, Month of..............190

Date and Place	Initial, Kind & No. of Car	WHEELS AND AXLES REMOVED					WHEELS OR AXLES APPLIED							
		Maker	Date Cast	No. on Wheel or Axle	Cause of Remo'l	Shop Mark on Wheels and Axles	Maker	Date Cast	No. on Wheel or Axle	New or Second Hand	Shop Mark on Wheels and Axles	Material Net Charge	Labor Charge	Total Net Charge

Date....................190   *Received payment, $..............................*

....

STATEMENT OF REPAIRS MADE PER M. C. B. RULES TO________CARS

BY________________________________RAILWAY CO.

DURING____________________190__

Repairs Made		CAR		DESCRIPTION OF PARTS REPAIR'D	Value of Miscellaneous Material	IRON			BRASS		Chain	Lumber	Spring		Labor	CREDIT FOR SCRAP					
Date	Place	Init'ls	No.			Cast	Wrot.	Mall.	Filled	Solid						Cast	Wrot. and Steel	Mall.	Steel Spring &Chain	Solid Brass	Filled Brass
						Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Ft.	Lbs		Hrs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs
				Quantity,																	
				Price.											20c						
				Value,																	
																			Total.		
																			Less for Scrap.		
																			Net Charge.		

RULE 89. Bills rendered for wheels and axles shall be in accordance with the following schedule of prices for material, with the proper debits and credits:

	NEW.	SECOND-HAND.	SCRAP.
One 36-in. cast-iron wheel........	$10.50	$ 7.75	$5.25
One 33-in. cast-iron wheel........	9.00	7.00	4.75
One 33-in. steel or steel-tired wheel	23.00	17.25	5.00
One axle, 100,000 lbs............	21.50	11.75	7.75
One axle, 80,000 lbs.............	17.75	10.00	6.50
One axle, 60,000 lbs.............	14.00	7.75	5.25
One axle, 50,000 lbs. (or under)..	11.50	6.25	4.25

and with an additional charge for all labor for each pair of wheels and axles removed from all arch bar trucks of $1.75, and from all solid pedestal trucks of $2.00. If new wheels and axles are substituted for secondhand wheels and axles, proper charges and credits shall be allowed, although such substitution be made on account of only one loose or defective wheel, or a defective axle, with the following exceptions: In case the owner of a car removes a damaged wheel or axle, no charge shall be made for any difference in value between the parts used and those removed that are not damaged.

Removing, turning and replacing a pair of steel or steel-tired wheels: $3.25 for pedestal type of truck and $3.00 for archbar truck.

Loss of service metal from steel or steel-tired wheels for defects for which the delivering company is responsible, to be charged for at the rate of $1.50 per 1-16 inch thickness of tread or tire.

RULE 90. If car owner elects on account of improper repairs to remove M. C. B. standard axles suitable to the capacity of the car, he shall make charge for secondhand axles and allow credit for secondhand axles if they are in good order. Axles removed below the journal limit of 100,000 pounds, 80,000 pounds, 60,000 pounds and 40,000 pounds capacity to be credited as scrap when removed.

RULE 91. Bills for wheel and axle work must make specific mention of each axle and wheel removed or applied.

RULE 92. Bills which do not embody all the information called for by the headings of the columns may be declined until made to conform to the requirements of the rule. If no marks are found on wheels or axles removed, a notation to that effect must be made on face of bill.

RULE 93. In noting on bills the cause of removal of wheels and axles, the terms used in Rules 7 to 24, inclusive, shall be used, and the dimensions of the defect or variation from the prescribed limits should be carefully specified.

RULE 94. Bills for repairs made under these rules and for material furnished shall be in conformity with schedules of prices and credits for the articles enumerated below:

MATERIAL.	8-INCH.	10-INCH.
Air-brake Equipment:		
Air-brake hose, 1¼ inch, complete with fittings, applied to car charge...........................	$2.00	$2.00
Air-brake hose, 1¼ inch, credit for fittings for same	.80	.80
Angle cock, plain handle........................	1.50	1.50
Angle cock, self-locking handle..................	1.80	1.80
Angle cock handle...........................	.08	.08
Auxiliary reservoir	2.75	6.25
Cut-out cock	1.30	1.30
Cut-out cock handle..........................	.07	.07
Cylinder body	2.00	3.50
" *piston* and rod........................	1.00	1.50
" " follower	.08	.25
" " packing leather	.60	1.00
" " " " expander	.05	.08

MATERIAL.	8-INCH.	10-INCH
Cylinder piston release spring	$0.50	$0.50
“ non-pressure head	.60	1.25
“ gasket	.06	.08
Gasket, air-hose coupling	.04	.04
Pipe nipple, on end of train pipe	.12	.12
Pressure-retaining valve, 2 position	1.00	1.00
Pressure-retaining valve, 3 position	2.25	2.25
Release valve	.60	.60
Release valve handle	.08	.10
Release rod	.10	.10
Spring cotter pins for key bolts and brake pins, each, applied	.02	.02
Train pipe air strainer (1¼ inch)	.60	.60
Triple check valve case	.90	.90
“ cylinder cap (drain cup)	.75	.75
“ cylinder cap (drain cup) gasket	.40	.40
“ emergency valve	.60	.60
“ “ “ seat	.55	.55
“ “ “ piston	.50	.50
“ “ “ rubber seat	.05	.05
“ “ check valve	.25	.25
“ “ “ spring	.02	.02
“ “ “ case gasket	.10	.10
“ graduating spring	.05	.05
“ “ stem	.15	.15
“ “ “ nut	.20	.20
“ “ valve	.05	.05
“ piston and ring	2.00	2.00
“ “ ring (only)	.25	.25
“ slide valve	.75	.75
“ “ “ spring	.03	.03
“ valve strainer	.05	.05
“ “ gasket	.20	.20

MATERIAL.	CHARGE.	CREDIT.
Bolts, nuts and forgings, finished, per lb.	$0.03	$0.00¾
Brake shoes applied; no credit for scrap	.30	....
Brake shoe, reinforced back, applied; no credit for scrap	.40	....
Brake shoe key, applied; no credit for scrap	.05	....
Castings, rough iron ... per lb.	.02	.06-10
“ “ mall'ble ... “ “	.03½	.00½
“ “ steel ... “ “	.04½	.00¾
Chain	.05	.01
Coupler, M. C. B., complete, new, steel, 5 by 5 shank	8.75	....
Coupler, M. C. B., complete, new, steel, 5 by 7 shank	9.50	....
Coupler body, one, new steel, 5 by 5 shank	6.50	1.05
Coupler body, one, malleable, 5 by 5 shank	....	.90
Coupler body, one, new, steel, 5 by 7 shank	7.75	1.15
Coupler body, one, malleable, 5 by 7 shank	....	1.00
Coupler knuckle, one, new, open	....	.40
Coupler knuckle, one, new solid	2.00	.45
Coupler knuckle pin, one, new	.25	.05
Coupler lock, one, new	.40	.06
Other individual mall'ble, wrought or steel parts, per lb.	.04	....
Door, for end of box or stock car, wooden, each, applied; no credit for scrap	1.95	....
Door, for end of box or stock car, ventilated (wooden frame with iron rods), each, applied; no credit for scrap	3.30	....
Door, for side of box or stock car, wooden, each, applied; no credit for scrap	3.85	....

MATERIAL.	CHARGE.	CREDIT.
Door, for side of box or stock car; ventilated (wooden frame with iron rods), each, applied; no credit for scrap	$5.50	....
Door, for side of carriage, automobile or furniture car, wooden, each, applied; no credit for scrap	5.00	....
Door, for side of stock car, with iron rods, each, applied; no credit for scrap	4.40	....
Door, for roof of coke car, wooden, each, applied; no credit for scrap	2.45	....
Door, for roof of stock car, wooden, each, applied; no credit for scrap	.85	....
Half door, for side of box or stock car, each, applied; no credit for scrap	2.50	....
Half door, for end of furniture or carriage car, each, applied; no credit for scrap	3.00	....
Hatch cover, for roof of refrigerator car, wooden, each, applied; no credit for scrap	1.50	....
Hatch plug, for refrigerator car, wooden, each, applied; no credit for scrap	1.50	....
Iron, galvanized per lb.	.04	....
Journal bearings, brass or bronze, lined or unlined, per lb., applied	.20	.15
Journal bearings, filled brass or bronze shell, per lb., applied	.15	.11

The weight charged for new journal bearings for 7-inch journals and over, but not 8 inches long, shall be 10 pounds; for scrap bearings, 6 pounds. The weight charged for new journal bearings for journals 8 inches long and less than 9 inches long shall be 13 pounds; for scrap bearings 8 pounds. For new journal bearings for journals 9 inches long or over, but not 10 inches, 20 pounds; for scrap bearings, 12 pounds. For new journal bearings for 100,000-pound capacity cars (5½ by 10 inches) the weight shall be 25 lbs.; for scrap bearings, 15 pounds.

MATERIAL.	CHARGE.	CREDIT.
Journal bearings, cast steel or malleable iron back, credit for scrap, per pound	....	.04
Labor, per hour	.24	....
Lumber—yellow, white and Norway pine, poplar, oak, hickory and elm, dressed and framed, per ft. B. M. required to make the part	.03½	....
Nails per lb.	.03	....
Paint, lead, freight car mixed " "	.15	....
Paint, mineral, freight car, mixed " "	.05	....
Pipe, ⅜ inch, per foot	.03	....
" 1 " " "	.05	....
" 1¼ " " "	.07	....
Steel for springs, rough per lb.	.05	.00¾
" helical springs " "	.03½	.01
" pressed and sheet " "	.03½	.00½

RULE 95. Not more than one pound of mineral paint can be charged for 15 square feet of surface covered, and not more than one pound of lead paint for 12 square feet of surface covered. No charge to be made for lettering.

RULE 96. Whenever scrap credits are allowable the weights of scrap credited shall be equal to the weights of the new metal applied, except as otherwise provided in the rules, and except in the case of scrap M. C. B. couplers, and parts of same, and material applied on defect cards, in which cases the weight and kind of metal removed shall be credited.

RULE 97. In the application of structural steel it should be charged out at the current market price plus the necessary labor for drilling, etc.; credit should be at prices quoted above for similar metal.

RULE 98. Bills shall not be rendered for amounts less than 25 cents in aggregate, but charges for items less than 25 cents may be held until they amount to that sum, provided said aggregate is rendered within 60 days. No bill shall be returned for correction on account of error for less than 100 cents in aggregate of bill, but said bill shall be passed for payment at once, and the alleged error brought to the attention of the road rendering the same within sixty days from date of bill. The receiving road shall at once issue a letter of authority for counter-bill to cover the acknowledged error, said letter to be attached to the bill as authority.

No bills shall be returned for correction on account of wrong car numbers, but road rendering bill should be communicated with by letter, and if, after investigation, it is found to be a fact that wrong car number has been given, correct number shall be furnished or credit covering amount of charge allowed on next month's bill.

When necessary to return bills for correction, all defect cards and repair card stubs should be detached except those covering repairs to cars, the charge for which there may be some question as to its correctness.

RULE 99. All companies rendering bill should consolidate all charges against any one company into one monthly bill.

RULE 100. Journal bearings having a lining ⅜ inch thick or thicker, shall be charged as filled journal bearings, and not as lined journal bearings.

RULE 101. In rendering bills for owner's defects, the following should be observed:

No credit for scrap and no charge for labor shall be allowed in renewing brake shoes.

RULE 102. When M. C. B. coupler parts or metal brake beams are replaced, good secondhand material may be used, but they must be charged at seventy-five per cent of the prices when new. The credits for similar parts released from service in good condition must also be seventy-five per cent of the prices when new.

RULE 103. Manufactured articles not included in the above list must be charged at current market prices, without freight charges.

RULE 104. No percentage to be added to either material or labor.

RULE 105. Bills for the following work, to make cars conform to United States laws and to conform to the requirements of Rule 64, must be rendered within 60 days after the work is done, and must state the height of the car before and after altering:

Altering height of one end of one car, net	$1.25
Putting on one handhold or grabiron, net	.25

RULE 106. The following table shows the number of hours which may be charged for labor in doing the various items of work enumerated, which includes all work *necessary to* complete each item of repairs, except in so *far as labor is* already included in charges for materials.

	Ordinary Cars.		Refrigerator Cars.	
	Hrs.	Charge for Labor.	Hrs.	Charge for Labor.
Advertisements, temporary, tacked on cars, removing, per car	...	$ 0.50	...	$ 0.50
Advertisements, temporary, pasted, glued or varnished on cars, removing, per car	...	1.00	...	1.00
American continuous draft rods, one rod, welding	2	.48	2	.48
Arch bars, 1 or 2, replaced on same side of truck	3	.72	3	.72
Arch bar, upper or lower, or both, blacksmith shop labor, repairing	2	.48	2	.48
Axle, bent, straightening	4	.96	4	.96
Bolster, body, composite, one, repl.	10	2.40	12	2.88
Bolster, body, plain metal or wood, one, replaced	8	1.92	10	2.40
Bolster, body, plain metal or wood, one, replaced when one or more defective sills are replaced	2	.48	2	.48
Bolster, composite, one, replaced when one or more defective sills are replaced	4	.96	4	.96
Bolster, truck, one, replaced	10	2.40	10	2.40
Bolster, truck, one, and one spring plank in same truck, replaced	12	2.88	12	2.88
Brake beam, one, replaced	2	.48	2	.48
Brake beam, one, metal, blacksmith labor repairing	2	.48	2	.48
Brake beam, wooden truss, repairing.	1	.24	1	.24
Brake hanger, repaired and replaced.	1	.24	1	.24
Brake shoe, applied on authority of defect card, when brake beam is not replaced	½	.12	½	.12
Buffer blocks, cast iron, each, replacing	1	.24	1	.24
Carlin, one, replaced	3	.72	...	...
Carrier iron bolts, three or less, at one end of car, applied	2	.48	2	.48
Carrier iron bolts, all at one end of car, applied	3	.72	3	.72
Carrier iron bolts, 4 inches long or less, each	¼	.06	¼	.06
Center pin (head) applied, empty car	½	.12	½	.12
Center pin (head) applied, loaded car	3	.72	3	.72
Center pin (head) applied, empty car, and putting same end on center	1½	.36	1½	.36
Center pin (head) applied, loaded car, and putting same end on center	5	1.20	5	1.20
Center pin (key) applied, empty car, including placing same end on center, if necessary	1½	.36	1½	.36
Center pin (key) applied, loaded car, including placing same end on center, if necessary	2½	.60	2½	.60
Center plates, one or two, at same end, replacing	3	.72	3	.72
Center plate bolts, where same do not pass through draft timber, one or more, or all at same end	3	.72	3	.72

	Ordinary Cars.		Refrigerator Cars.	
	Hrs.	Charge for Labor.	Hrs.	Charge for Labor.
Center plate bolt or bolts and center plate, replacing, on one end of car.	3	$ 0.72	3	$ 0.72
Column bolts, one or more, replaced in same truck..................	2	.48	2	.48
Corner iron, one, replaced..........	1	.24	1	.24
Corner post, one, replaced, empty car	3	.72	6	1.44
Corner post, one, replaced, loaded car	4	.96	6	1.44
Coupler, with stem attachments, coupler springs, one or more follower plates, American continuous draft key, American continuous draft rods, one or more coupler stops, renewing or replacing any or all, at same end of car, at same time....	3	.72	3	.72
Coupler, with pocket attachments, coupler spring, one or more follower plates, one or more coupler stops, coupler pocket, coupler pocket rivets, renewing or replacing any or all, at same end of car at same time	4	.96	4	.96
Coupler stop bolts, lug strap bolts or draft timber cross-tie bolts, 5 or less, at same end of car, when coupler is not replaced, each..........	½	.12	½	.12
Coupler stop bolts, lug strap bolts or draft timber cross-tie bolts, 6 or more, at same end of car, when coupler is not replaced..........	3	.72	3	.72
Cross-tie timber, one, replaced......	3	.72	3	.72
Cross-tie timber, one, replaced when one or more defective sills are replaced	1	.24	1	.24
Dead block, wooden, replacing at one end of car.....................	3	.72	3	.72
Door, end, old, rehanging..........	½	.12	..	....
Door, side, old, rehanging..........	1	.24	1	.24
Door post, one, replaced, empty car..	3	.72	6	1.44
Door post, one, replaced, loaded car..	4	.96	6	1.44
Draft timber, one, replaced.........	7	1.68	7	1.68
Draft timbers, two, on same end, replaced	10	2.40	11	2.64
Draft timber, one, renewed, when upper center plate bolts pass through rear end of draft timbers........	10	2.40	10	2.40
Draft timbers, two, renewed, when upper center plate bolts pass through rear end of draft timbers........	13	3.12	14	3.36
Draft timber, one, renewed, when its center sill is renewed or spliced at same end of car................	2	.48	2	.48
Draft timber, one, renewed, when its opposite center sill at same end of car is renewed or spliced.........	3	.72	3	.72
Draft timber bolts complete, at one end of car, replacing............	3	.72	3	.72
Draft timber bolts, or carrier iron *bolts, either or* both, three or less, *at one end of* car, replacing......	2	.48	2	.48

	Ordinary Cars. Hrs.	Ordinary Cars. Charge for Labor.	Refrigerator Cars. Hrs.	Refrigerator Cars. Charge for Labor.
Draft timber bolts, or carrier iron bolts, either or both, four or more, at one end of car, replacing	3	$0.72	3	$0.72
Draft timber bolts, when same do not pass through upper center plate, three or less	2	.48	2	.48
Draft timber bolts, when same do not pass through upper center plate, four or more	3	.72	3	.72
Draft timber bolts, when one or more of the bolts pass through the center plate, add	3	.72	3	.72
(No additional charge to be made in this case, if one or more or all of the center plate bolts at same end of car are renewed.)				
Draft timber bolts, four or more at one end of car, replacing	3	.72	3	.72
End plank, one, renewed on gondola car—				
without angle irons	2	.48	..	....
with angle irons, bolted	3	.72	..	....
with angle iron, riveted	5	1.20	..	....
End planks, two, renewed on same end,				
without angle irons	2½	.60	..	....
with angle irons, bolted	3½	.84	..	....
with angle irons, riveted	5½	1.32	..	....
End planks, three, renewed on same end—				
without angle irons	3	.72	..	....
with angle irons, bolted	4	.96	..	....
with angle irons, riveted	6	1.44	..	....
End planks, four, renewed on same end—				
without angle irons	3½	.84	..	....
with angle irons, bolted	4½	1.08	..	....
with angle irons, riveted	6½	1.56	..	....
End plate, one, replaced	12	2.88	14	3.36
End post, one, replaced, empty car	3	.72	6	1.44
" " " replaced, loaded car	4	.96	6	1.44
Journal box, one, replaced	2	.48	2	.48
Journal boxes, two, on same axle, replaced	3	.72	3	.72
Journal box, one or two, replaced on same axle, solid pedestal truck	4	.96	4	.96
Journal box, three or four, replaced, same truck, solid pedestal truck	5	1.20	5	1.20
Journal box bolt, one or two, replaced, same box	1	.24	1	.24
Journals, truing up one or two, on same axle	2	.48	2	.48
Platform plank, one, replaced	1	.24	1	.24
Releasing rod for M. C. B. coupler, one, replaced	½	.12	½	.12
Roof boards, single, including removing and replacing running board, per lineal foot	..	.07	..	.07
Roof boards, double board roof, including removing and replacing running board, per lineal foot	..	.08	..	.08

	Ordinary Cars.		Refrigerator Cars.	
	Hrs.	Charge for Labor.	Hrs.	Charge for Labor.
Running board, complete, applied	6	$1.44	6	$1.44
Spring plank, one, replaced	10	2.40	10	2.40
Side plank, one, renewed on gondola car—				
without angle irons	4	.96	..	....
with angle irons, bolted	7	1.68	..	....
with angle irons, riveted	8	1.92	..	....
Side planks, two, renewed on same side—				
without angle irons	5½	1.32	..	...
Side planks, two, with angle irons, bolted	8	1.92	..	...
with angle irons, riveted	9	2.16	..	....
Side planks, three, renewed on same side—				
without angle irons	7	1.68	..	....
with angle irons, bolted	9	2.16	..	....
with angle irons, riveted	10	2.40	..	....
Side planks, four, renewed on same side—				
without angle irons	8½	2.04	..	....
with angle irons, bolted	10	2.40	..	....
with angle irons, riveted	11	2.64	..	....
Side plate, one, applied	25	6.00	35	8.40
“ “ “ spliced	8	1.92	15	3.60
Side post, one, replaced	3	.72	6	1.44
Siding, removed and replaced, per lineal foot	..	.15	..	.15
Siding, removed and replaced, where nails are set and holes puttied	..	....	..	.20
SILLS.				
1 center sill, spliced	16	3.84	20	4.80
2 center sills, spliced	22	5.28	26	6.24
1 center sill, replaced	35	8.40	47	11.28
2 center sills, replaced	41	9.84	68	16.32
1 end sill under siding, replaced	15	3.60	15	3.60
1 end sill outside siding, replaced	7	1.68	7	1.68
1 end sill under siding, replaced when one or more defective sills have been replaced	3	.72	3	.72
1 end sill under siding, renewed, when one or more defective sills have been spliced	10	2.40	10	2.40
1 end sill outside siding, replaced when one or more defective sills have been replaced	2	.48	2	.48
1 end sill, outside siding, renewed, when one or more defective sills have been spliced	3	.72	3	.72
1 intermediate sill, replaced	32	7.68	43	10.32
2 “ “ “	38	9.12	59	14.16
3 “ “ “	44	10.56	69	16.56
4 “ “ “	50	12.00	79	18.96
1 inter. sill and 1 center sill replaced	41	9.84	63	15.12
1 “ “ “ 2 “ sills “	47	11.28	84	20.16
2 “ *sills* “ *1* “ sill “	46	11.04	73	17.52
2 “ “ “ *2* “ sills “	53	12.72	94	22.56
“ “ “ *1* “ sill	51	12.24	83	19.92

	Ordinary Cars.		Refrigerator Cars.	
	Hrs.	Charge for Labor.	Hrs.	Charge for Labor.
3 inter. sills and 2 center sills replac'd	63	$15.12	104	$24.96
4 " " " 1 " sill "	63	15.12	93	22.32
4 " " " 2 " sills "	68	16.32	114	27.36
1 intermediate sill, spliced..........	11	2.64	14	3.36
1 side sill and 1 center sill, replaced.	51	12.24	68	16.32
1 " " " 2 " sills " .	56	13.44	89	21.36
2 " sills " 1 " sill " .	71	17.04	89	21.36
2 " " " 2 " sills " .	74	17.76	110	26.40
1 " sill spliced	12	2.88	15	3.60
1 " sill replaced	25	6.00	44	10.56
2 " sills replaced	40	9.60	65	15.60
1 " sill and 1 inter. sill replaced..	47	11.28	63	15.12
1 " " " 2 inter. sills replaced.	53	12.72	73	17.52
1 " " " 3 " " " .	59	14.16	83	19.92
1 " " " 4 " " " .	65	15.60	93	22.32
2 " sills " 1 " sill " .	61	14.64	84	20.16
2 " " " 2 " sills " .	67	16.08	94	22.56
2 " " " 3 " " " .	73	17.52	104	24.96
2 " " " 4 " " " .	79	18.96	114	27.36
1 " 1 inter. and 1 center sill repl..	56	13.44	84	20.16
2 " 1 " " 1 " " " ..	77	18.48	105	25.20
1 " 2 " " 1 " " " ..	61	14.64	94	22.56
2 " 2 " " 1 " " " ..	79	18.96	115	27.60
1 " 3 " " 1 " " " ..	66	15.84	104	24.96
2 " 3 " " 1 " " " ..	84	20.16	125	30.00
1 " 4 " " 1 " " " ..	71	17.04	114	27.36
2 " 4 " " 1 " " " ..	89	21.36	135	32.40
1 " 1 " " 2 " sills " ..	61	14.64	105	25.20
2 " 1 " " 2 " " " ..	79	18.96	126	30.24
1 " 2 " " 2 " " " ..	66	15.84	115	27.60
1 " 3 " " 2 " " " ..	72	17.28	125	30.00
1 " 4 " " 2 " " " ..	77	18.48	135	32.40
2 " 2 " " 2 " " " ..	84	20.16	136	32.64
2 " 3 " " 2 " " " ..	89	21.36	146	35.04
2 " 4 " " 2 " " " ..	94	22.56	156	37.44
Each side or inter. sill spliced, when longitudinal sills have to be replaced, or when other sills are spliced at same end............	3	.72	3	.72
1 center sill, spliced, when intermediate or side sills have to be replaced	8	1.92	9	2.16
1 center sill, spliced, when other center sill has to be replaced.........	6	1.44	7	1.68
Stakes, end, on gondola cars, applied, each	1½	.36	...	....
Stakes, side, on gondola cars, applied each	1½	.36	...	....
Truck springs, one or all, in same truck, replacing	2	.48	2	.48
Truck transom, one, wood, replaced...	10	2.40	10	2.40
Truck transoms, two, wood, replaced in same truck..................	12	2.88	12	2.88
Weighing and re-stenciling, car, per rule 72	1¼	.30	1¼	.30
When necessary to remove load to replace body center plate, bolt or bolts, one or two draft timbers, or *draft timber bolts*, at one end of car	3	.72	3	.72

REPAIRS OF STEEL OR STEEL PARTS OF COMPOSITE CARS.

All rivets, 10 cents per rivet, which covers removal and replacing of rivets, including removing, fitting, punching or drilling holes when applying patches or splices and replacing damaged parts, not to include straightening or repairing.

Straightening or repairing parts removed from damaged car, 50 cents per 100 pounds.

Straightening or repairing parts in place in damaged car; also any parts that require straightening, repairing or renewing, not included on rivet basis, 24 cents per hour.

Credit for scrap material removed from cars constructed of pressed or structural steel, ½ cent per pound.

RULE 107. No charge to be made for labor of replacing or applying M. C. B. knuckles, knuckle pins, locking pins, clevises, clevis pins, lift chains, brake shoes or brake-shoe keys, except on the authority of a defect card.

No charge to be made for adjusting brakes.

RULE 108. When it is necessary to apply an M. C. B. coupler complete, on account of a broken or missing knuckle, the usual labor charge for replacing a coupler can be made.

RULE 109. No additional labor to be charged for applying center pins or friction rollers or for putting car on center when center-plate bolts or center plates are renewed on same end of car.

RULE 110. No additional labor to be charged for renewing dead block or platform plank if end sill at same end is renewed or replaced.

RULE 111. No additional labor to be charged for replacing or renewing coupler when one or both draft timbers are replaced or renewed at the same end of car at the same time.

When one or more carrier iron bolts are replaced, where coupler at same end of car is removed and replaced for any other reason, the regular labor charge should be reduced one hour.

RULE 112. The following table shows the labor charges allowable for air-brake repair work: The letters "R. & R." mean "removed and replaced."

	Cents.
Air hose, R. & R.	3
Angle cock, R. & R.	7
Angle cock handle, R. & R.	4
Angle cock, grinding in	28
Check valve case, spring, gasket, or all R. & R.	10

DETAILS.	Cents.
Disconnecting union	3
Check valve case (two cap screws)	2
Emergency valve seat	5
Total	10

Coupler dummy, R. & R. (1 lag screw)	1
Cut-out cock, R. & R.	9

DETAILS.	Cents.
1 union disconnected	3
2 pipe connections	6
Total	9

Cut-out cock handle, R. & R.	4
Cylinder, R. & R.	30

DETAILS.	Cents.
Push rod (1 connecting pin)	3
Clamping piston (1 cap screw)	2
Cylinder head, R. & R. (4 nuts, ½ inch, 1 cent each)	4
Disconnecting cylinder from reservoir (7 nuts, ½ inch, 1 cent each)	7
Reclamping cylinder piston (1 cap screw)	2
Removing cylinder from car (6 nuts, ⅝ inch, 2 cents each)	12
Total	30

Cylinder and reservoir, R. & R.	41

DETAILS.	Cents.
Removing push rod (1 connecting pin)	3
Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
Removing cylinder from car (6 nuts, ⅝ inch, 2 cents each)	12
Removing reservoir from car (2 nuts, ⅝ inch, 2 cents each)	4
Removing release rods (2 spring cotters)	4
Removing release valve	2
Removing two plugs	2
Removing triple (2 nuts, ⅝ inch, 2 cents each)	4
Disconnecting train pipe union	3
Disconnecting retaining pipe unions	3
Total	41

	Cents.
Cylinder and reservoir, tightening when loose (8 nuts, 1c each)	8
Cylinder cleaned, oiled, tested and stenciled	33

DETAILS.	Cents.
Removing push rod (1 connecting pin)	3
Clamping piston (1 cap screw)	2
Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
Cleaning, testing and stenciling	24
Total	33

Cylinder release spring, R. & R.	11

DETAILS.	Cents.
Removing push rod (1 connecting pin)	3
Clamping cylinder piston (1 cap screw)	2
Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
Reclamping cylinder head (1 cap screw)	2
Total	11

Cylinder gasket, R. & R.	25

DETAILS.	Cents.
Disconnecting triple union	3
Disconnecting retaining pipe union	3
Disconnecting reservoir block (2 nuts, ⅝ inch, 2 cents each)	4
Disconnecting reservoir from cylinder (7 nuts, ½ inch, 1 cent each)	7
Removing push rod (1 connecting pin)	3
Clamping cylinder piston	1
Removing release rods (2 spring cotters)	4
Total	25

	Cents.
Emergency check valve, grinding in	10
Emergency valve piston, R. & R.	10

DETAILS.	Cents.
Disconnecting union	3
Removing check valve case (2 cap screws)	2
Removing emergency valve seat	5
Total	10

Emergency valve seat, R. & R. (see E. V. piston)	10
Emergency valve, rubber seat, R. & R.	10

DETAILS.	Cents.
Disconnecting union	3
Removing check valve case (2 cap screws)	2
Removing riveted pin	4
Removing emergency valve nut	1
Total	10

Cylinder piston packing R. & R.	13

DETAILS.	Cents.
Removing push rod (1 connecting pin)	3
Clamping cylinder piston (1 cap screw)	2
Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
Removing leather packing (4 nuts, ½ inch, 1 cent each)	4
Total	13

Cylinder piston, R. & R.	15

DETAILS.	Cents.
Removing push rod (1 connecting pin)	3
Clamping cylinder piston (1 cap screw)	2
Removing cylinder head (4 nuts, ½ inch, 1 cent each)	4
Removing leather packing (4 nuts, ½ inch, 1 cent each)	4
Reclamping cylinder piston (1 cap screw)	2
Total	15

Gasket, coupling, R. & R.	2
Graduating nut, stem, spring or all, R. & R.	2
Oil plugs, R. & R., each	2
Packing leather expander, R. & R. (see cylinder *piston)*	2

	Cents.
Pipe, train or branch, R. & R., for each connection made	3
Push rod, R. & R. (1 connecting pin)	3
Release valve, R. & R.	6

DETAILS.	Cents.
Disconnecting release rod (2 spring cotters)	4
Disconnecting release valve	2
Total	6

Release valve, removed, repaired and replaced (R. & R. 4c.)	9
Release valve rod, removed, repaired and replaced	3

DETAILS.	Cents.
1 spring cotter	2
Removing staple	1
Total	3

Reservoir, R. & R.	29

DETAILS.	Cents.
Removing from car (2 nuts, ⅝ inch, 2 cents each)	4
Disconnecting from cylinder (7 nuts, ½ inch, 1 cent each)	7
Removing release rods (2 spring cotters)	4
Removing release valve	2
Removing two plugs	2
Removing triple valve (2 nuts, ⅝ inch, 2 cents each)	4
Disconnecting union	3
Disconnecting union, retaining pipe	3
Total	29

Removing cylinder cap (3 nuts, ½ inch, 1c each)	3
Removing slide valve (3 nuts, ½ inch, 1c each)	3
Repairing retaining valve (R. & R. 5c)	10
Retaining valve, R. & R. (2 lag screws 2c, valve 3c)	5
Slide valve, removed, ground in and replaced	33
Slide valve spring, R. & R.	6

DETAILS.	Cents.
Cylinder cap (3 cap screws)	2
Removing riveted pin	4
Total	6

Strainer, R. & R. (disconnecting union)	3
Triple cylinder cap, R. & R. (3 nuts, ½ inch, 1c each)	3
Triple cylinder cap gasket, R. & R. (3 nuts, ½ inch, 1c each)	3
Triple piston packing ring, fitted	17
Triple valve, removed, cleaned, oiled, tested and stenciled	40

DETAILS.	Cents.
Train pipe union disconnected	3
Retaining pipe union disconnected	3
Removing triple (2 nuts, ⅝ inch, 2 cents each)	4
Check valve case (2 cap screws)	2
Emergency valve seat	5
Cylinder cap (3 bolts)	3
Cleaning, testing and stenciling	20
Total	40

Triple valve gasket, R. & R.	10

DETAILS.	Cents.
Disconnecting branch pipe union	3
Disconnecting retaining pipe union	3
Removing triple (2 nuts, ⅝ inch, 2 cents each)	4
Total	10

Unions disconnected and connected	3

The following basic units were used in determining the details of prices given above. These units are not to be used in rendering bills, but may be used in the determination of cost of other combinations of air-brake repairs not above mentioned.

	Cents.
Cap screws or studs or bolts, R. & R., 1 or more	2
Cylinder cleaning, testing and stenciling	24
Emergency valve seat, R. & R.	5
Graduating stem nut, R. & R.	2
Lag or wood screws, R. & R., each	1
Nuts tightened when loose, each	1
Nuts, ½ inch or less, R. & R., 1 or 2 on same bolt	1
Nuts, ⅝ inch or over, R. & R., 1 or 2 on same bolt	2
Pins connecting R. & R. (including split key)	3
Pins riveted, R. & R., each	4
Plugs, oil, R. & R., each	1
Spring cotters, R. & R., each	2
Staples, R. & R., each	1
Testing air (after repairs)	5
Threads on pipe, cutting, per coupling	5
Train or branch pipe, disconnected and connected, or only connected, each connection	3
Triple valve, cleaning, testing and stenciling	20
Union disconnected and connected	3

RULE 113. The settlement prices of new eight-wheel cars shall be as follows, with an addition of $27.50 for each car equipped with 8-inch air-brake equipment and $35 for 10-inch air-brake equipment. The road destroying a car with air brakes may elect to return the air-brake apparatus, including such attachments as are usually furnished by the air-brake manufacturer, complete and in good condition:

BODIES.

Wood.

Box car, eight-wheel, 40 feet long or over	$440.00
Box car, eight-wheel, 36 feet long or over, but under 40 feet	385.00
Box car, eight-wheel, 34 feet long or over, but under 36 feet long	360.00
Box car, eight-wheel, 32 feet long or over, but under 34 feet long	330.00
Box car, eight-wheel, under 32 feet long	265.00
Box car, ventilated, eight-wheel, 40 feet long or *over*	470.00

Box car, ventilated, eight-wheel, 36 feet long, but under 40 feet	$415.00
Box car, ventilated, eight-wheel, 34 feet long, but under 36 feet	385.00
Flat car, eight-wheel, plain, 40 feet long or over	200.00
Flat car, eight-wheel, plain, 32 feet long or over, but under 40 feet	155.00
Flat car, eight-wheel, plain, under 32 feet long	110.00
Gondola car, eight-wheel, drop-bottom, 40 tons capacity or over	330.00
Gondola car, eight-wheel, drop-bottom, 30 tons capacity or over, but under 40 tons	300.00
Gondola car, eight-wheel, drop-bottom, 25 tons capacity or over, but under 30 tons	275.00
Gondola car, eight-wheel, drop-bottom, 20 tons capacity or under	200.00
Gondola car, eight-wheel, hopper-bottom, 50 tons capacity	440.00
Gondola car, eight-wheel, hopper-bottom, 40 tons capacity or over, but under 50 tons	360.00
Gondola car, eight-wheel, hopper-bottom, 30 tons capacity or over, but under 40 tons	330.00
Gondola car, eight-wheel, hopper-bottom, 25 tons capacity or over, but under 30 tons	290.00
Gondola car, eight-wheel, hopper-bottom, 20 tons capacity or less	220.00
Gondola car, eight-wheel, plain, 50 tons capacity and over	350.00
Gondola car, eight-wheel, plain, 40 tons capacity, but under 50 tons	300.00
Gondola car, eight-wheel, plain, 30 tons capacity, but under 40 tons	275.00

Gondola car, eight-wheel, plain, 25 tons capacity, but under 30 tons	$250.00
Gondola car, eight-wheel, plain, under 25 tons	140.00
Stock car, eight-wheel, 34 feet long or over	330.00
Stock car, eight-wheel, 32 feet long or over, but under 34 feet	300.00
Stock car, eight-wheel, under 32 feet long	265.00

The lengths of cars above mentioned refer to the lengths over the end sills.

In the case of double-deck stock cars, $25.00 may be added to the prices given above for stock cars.

Where the capacity of the car is 60,000 pounds or over, 10 per cent should be added to the above prices for the car bodies.

When cars of 60,000 pounds capacity or over, and so stenciled, have trucks with journals 4 inches or over in diameter when new, $40 per car shall be added to the figure as given above for the values of car bodies, when equipped with metal bolsters.

When cars are equipped with metal center sills, $40 shall be added to the values of bodies for cost of such metal sills.

Steel.

Box car, wooden body, metal underframe, eight-wheel, 50 tons capacity, 38 feet 6 inches or over, over end sills	$825.00
Box car, wooden body, metal underframe, eight wheel, less than 50 tons capacity, 36 feet long or over	740.00
Flat car, wooden floor, metal underframe, eight-wheel, 50 tons capacity, 40 feet over end sills	770.00

Flat car, wooden floor, metal underframe, eight-wheel, 40 tons capacity, 40 feet over end sills..	$590.00
Flat car, wooden floor, metal underframe, eight-wheel, 40 tons or over, but under 50 tons, 34 feet long over end sills, but under 40 feet.....	510.00
Gondola car, all metal, eight-wheel hopper-bottom, 50 tons capacity, 33 feet over end sills...	825.00
Gondola car, all metal, eight-wheel, drop-bottom, 50 tons capacity, 40 feet over end sills........	815.00
Gondola car, all metal, eight-wheel, plain, 50 tons capacity, 40 feet over end sills................	790.00
Gondola car, wooden body, metal underframe, eight-wheel, flat-bottom, 40 feet over end sills.	790.00
Gondola car, wooden body, metal underframe, eight-wheel, hopper-bottom, 32 feet over end sills, but under 40 feet.....................	650.00
Stock car, eight-wheel, wooden body, metal underframe, less than 50 tons capacity, 36 feet long or over..............................	715.00

TRUCKS.

50,000 pounds capacity, with metal transoms and wooden bolster, per pair....................	$215.00
60,000 pounds capacity or under, with wooden bolster, per pair.............................	215.00
60,000 pounds capacity but under 80,000 pounds, all metal, per pair..........................	315.00
80,000 pounds capacity but under 100,000 pounds, all metal, per pair..........................	400.00
100,000 pounds capacity or over, all metal, per pair	425.00

Prices include brake beams complete, truck levers, *dead-lever* guides and bottom-connection rods.

For trucks with steel or steel-tired wheels an additional allowance of $112 per car shall be made.

All trucks in service of 60,000 pounds capacity or over, which consist entirely of metal, with the exception of the spring plank, shall be known hereafter as all-metal trucks.

RULE 114. In the case of wooden car bodies the depreciation due to age shall be figured at 6 per cent per annum upon the yearly depreciated value of such car bodies.

In the case of all-steel car bodies the depreciation shall be figured at 5 per cent per annum.

In the case of car bodies with steel underframes the depreciation shall be figured at 5½ per cent per annum, with the exception of steel underframe flat cars having wooden floors, which shall be figured at 5 per cent per annum.

The depreciation on trucks other than all-metal, shall be figured at 6 per cent per annum.

The depreciation on all-metal trucks shall be figured at 5 per cent per annum.

Allowances for depreciation shall in no case exceed 60 per cent of the value new.

The amounts $27.50 and $35.00 for air brakes shall not be subject to any depreciation.

RULE 115. The bodies of refrigerator cars, stock cars permanently fitted for stall shipments, tank cars, except the tanks, and other freight cars, designed for special purposes, not referred to above, shall be settled for at the present cost price, as may be agreed to by the parties in interest, less the deduction for depreciation due to age, *which shall* be on the same basis as for regular freight *equipment.*

In the case of cars equipped with racks for carrying coke and for other such purposes, and also stock cars other than those permanently fitted for stall shipments with feeding and watering attachments, the actual cost of these equipments shall be added to the standard settlement price for such cars.

RULE 116. In rendering bills, cars shall be treated as belonging to companies or individuals whose name or initials they bear, except in case of Line Cars where the equipment list of the general officers of the Line designates a party to make settlement.

RULE 117. Switching roads will only be allowed to render bills against car owners for the following defects repaired by them: Roof lost on account of decay or faulty construction, worn-out brasses, broken truck springs, truck transoms, arch bars, draft-timber bolts, column bolts, truck hangers, truck transom truss rods, truck bolsters, truck bolster truss rods, oil boxes, spring planks, truck hanger pins, side bearings and center plates, center-plate bolts, center pins, followers, American continuous rods or keys, draft springs, couplers, knuckles and drawbar pockets and rivets, defective wheels as specified in Rules 7 to 18, inclusive, defective axles as described in Rules 22 and 23, worn-out parts of brakes as prescribed in Rule 30, cars not within the limits of standard height for couplers, as per Rule 39, safety appliances as prescribed by Rule 40, and grain doors and all inside or concealed parts of bodies of cars missing or damaged under fair usage as prescribed in Rule 38, provided the damage has not been caused by derailment or rough usage. They will be allowed to render bills direct against car owners on all car owners' defects on cars received by them from a railroad company, provided they procure joint evidence from the delivering road that such car owners' defect existed when the car was delivered by the railroad company, joint evidence to accompany the bill against the car owner.

RULE 118. A switching road is a corporation doing the major part of its business on a switching charge.

RULE 119. Bills may be rendered against car owners for the cost of applying temporary running boards and hand rails to make cars safe for trainmen.

DESTROYED CARS AND THE RETURN OF TRUCKS.

RULE 120. The company on whose line the bodies or trucks are destroyed shall report the fact to the owner immediately after their destruction, and shall have its option whether to rebuild or settle for the same.

RULE 121. If the company on whose lines the car is destroyed elects to rebuild either body or trucks, or both, the original plan of construction must be followed, and the original kind and qualities of materials used. The rebuilding must be completed within 60 days from the original date of damage or destruction. In such cases no allowance shall be made for betterments.

RULE 122. If only the body of a car is destroyed, and the company destroying it elects to return the trucks, they shall be put in good order, or accompanied by a defect card, covering all defects or improper repairs made by them for which owners are not responsible, and forwarded, within 60 days, free of freight or other charges, *to the nearest* point on the line of the company owning or *operating* the car, and the number, line and class of car destroyed shall be stenciled or painted on each truck so returned.

RULE 123. The company on whose line the body or trucks of a car are seriously damaged, but not destroyed, may notify the owner and ask an appraisement on the damage done to the car as a basis for the disposal of the damaged car.

RULE 124. For the mutual advantage of railway companies interested, the settlement for a car owned or controlled by a railway company, when damaged or destroyed upon a private track, shall be assumed by the railway company delivering the car upon such tracks.

SENDING HOME WORN-OUT AND DAMAGED CARS.

RULE 125. A car unsafe to load on account of general worn-out condition, due to age or decay, shall be reported to its owner, who must be advised of all existing defects. If the owner elects to have it sent home, he shall furnish two home cards, noting upon them existing defects and the route over which the car is to be returned to its owner. If the route coincides with that over which the car passed to the point where it became unserviceable, no liability shall be incurred as between the owner and the road handling the car, either for freight charges in handling the car or for car service during this movement.

Such cards shall be attached to each side of the body of the car. They shall be 3½ by 8 inches, and of the form shown below. They shall be printed on both sides, and shall be filled in on both sides with ink or black indelible pencil:

FROM

....R. R.

TO

.... R. R.

VIA

....

....

Car No.................Initials...............

To be shopped for..............................

....

....

....
(Head of Car Department)

RULE 126. A car which is safe to run, but unsafe to load on account of serious damage caused by wreck or accident, shall be reported to the owners for appraisement and disposition, and disposed of as provided in Rule 125, if the owner so elects.

RULE 127. In case of cars of private ownership sent home on account of general worn-out condition due to age or decay, such cars shall be entitled to as many miles of homeward movement, free of charge to owners, as they may have been handled over said line under load, and no mileage to be paid to owners by roads handling. If the haul necessary to get cars home is in excess of such loaded mileage, said excess will be billed against the owner at regular freight rates and the owner notified.

RULE 128. Private line cars sent home to owners on *account of* being wrecked or damaged in accident shall be regularly billed home free of charge to owners and owners notified, providing such homeward movement passes over roads which have handled the cars loaded, previous to their homeward empty movement; otherwise the damaged cars to travel home empty, free of charges and free of mileage according to home route; or, if owners prefer to have them billed home via direct line, then charges to accrue to such line over which cars were not entitled to free movement.

FURNISHING MATERIALS.

RULE 129. Companies shall promptly furnish to each other, upon requisition, and forward free over their own road, material for repairs of their cars damaged upon foreign lines, excepting that the company having car in its possession at the time shall provide from its own stock the following:

Lumber, forgings, hardware stock, paint, hairfelt, piping, air-brake material and all M. C. B. standard material.

Requisitions for such material shall specify that same is for repairs of cars, giving car number and initial of such car, together with pattern number or other data to enable correct filling of requisition.

CONDITIONS OF ACCEPTANCE OF THIS CODE.

RULE 130. Any car owner or railway company may become a party to this Code of Rules by giving notice through one of its general officers to the Secretary of the Master Car Builders' Association.

Railroad companies becoming subscribers to this Code of Rules must have a representative member in the Master Car Builders' Association.

Rule 131. Any car owner or railway company that is a party to this Code of Rules shall be bound by same through its successive revisions, until one of its general officers files with the Secretary of the Master Car Builders' Association its notification of withdrawal.

Rule 132. Acceptance or rejection of this Code of Rules must be as a whole, and no exception to an individual rule or rules shall be valid.

Settlement of Disputes.

Rule 133. In order to settle disputes arising under the rules, and to facilitate the revision of the rules at the annual conventions of the Association, an Arbitration Committee of five representative members shall be appointed annually by the Executive Committee; three members of this committee to constitute a quorum.

In case of any dispute or question arising under the rules between the subscribers to said rules, the same may be submitted to this committee through the secretary, in abstract, jointly, said abstract setting forth the point or points at issue, and each party's interpretation of the rules upon which its claim is based, clearly and concisely, not exceeding three typewritten pages of letter size, single space, which shall be signed by both parties to the dispute. Should one of the parties refuse or fail to furnish the necessary information, the committee shall use its judgment as to whether, with the information furnished, it can properly give its opinion. The decisions of the committee shall be final and binding upon the parties concerned. This committee shall report its decisions to the Association, and its report shall be incorporated in the annual report of proceedings of the Association.

REVISION OF THIS CODE OF RULES.

RULE 134. The Arbitration Committee shall ask for suggestions of changes, amendments and additions to these rules prior to each annual convention, which it shall consider, and it shall report its recommendations to the succeeding annual convention.

RULE 135. In the revision of these rules by the Association, a two-thirds vote shall be necessary for adoption.

RULE 136. Voting powers shall be the same as prescribed in the Constitution of the Master Car Builders' Association on matters pertaining to the adoption of standards and the expenditure of money.

RULE 137. This Code of Rules shall be introduced for the discussion and revision at one session of the Master Car Builders' Association convention each year.

RULE 138. This Code of Rules shall take effect September 1, 1908.

LIST OF CAR OWNERS AND RAILWAY COMPANIES

WHICH HAVE ADOPTED THE CODE OF RULES GOVERNI THE CONDITION OF, AND REPAIRS TO, FREIGHT CARS FOR THE INTERCHANGE OF TRAFFIC.

The following is a complete list of car owners and r way companies which have given notice of the adopt of the above Code of Rules.

Other companies which adopt this Code of Ru should notify the secretary, in accordance with the Rul so that the names of such companies may be included the list thereafter. Notice should be given of all chan in the names of companies in this list.

Alabama Great Southern.
Alabama & Mississippi.
Alabama & Vicksburg.
Alameda & San Joaquin.
Albany & Hudson.
Algoma Central.
Aliquippa & Southern.
Allegheny Valley.
American Cotton Oil Co.
American Fast Freight Line.
American Refrigerator Transit Co.
American Tank Line.
Ann Arbor.
Arkansas Central.
Arkansas, Louisiana & Gulf.

Arkansas, Louisiana & Southern.
Armour Car Lines.
Armour Packing Co.
Arms Palace Horse Car Co.
Astoria & Columbia River.
Atchison, Topeka & Santa Fe.
Atlanta, Knoxville & Northern.
Atlanta Stone, Coal & Lumber Line
Atlantic & Birmingham.
Atlantic & Pacific.
Atlanta & West Point.
Atlantic Coast Line.
Atlantic Seaboard Line.
Atlantic, Valdosta & Western.
Baltimore & Lehigh.
Baltimore & Ohio.
Baltimore & Ohio Southwestern.
Baltimore & Potomac.
Bangor & Aroostook.
Barberton Belt.
Barrett Mfg. Co.
Bay Terminal.
Beech Creek.
Bellefonte Central.
Bellingham Bay & British Columbia.
Bennington & Rutland.
Bessemer & Lake Erie.
Bessemer Coke Co.
Birmingham Southern.
Booth's Refrigerator Line.
Booth's Cold Storage System.
Boston & Albany.
Boston & Lowell.

Boston & Maine.
Boston, Hoosac Tunnel & Western.
Brimstone Railroad & Canal Co.
Bristol, Elizabethton & North Carolina.
Buffalo, Rochester & Pittsburg.
Buffalo & Susquehanna.
Burlington, Cedar Rapids & Northern.
Burlington & Missouri River in Nebraska.
Butte, Anaconda & Pacific.
Cairo, Vincennes & Chicago.
California Fruit Transportation Co.
Cammal & Black Forest.
Canada Atlantic.
Canada Southern.
Canadian Northern.
Canadian Pacific.
Canadian Northern Quebec.
Cananea Consolidated Copper Co.
Cananea, Yaqui River & Pacific.
Canda Cattle Car Co.
Carolina Central.
Carolina & North-Western.
Cape Girardeau South-Western.
Central Indiana.
Central New England.
Central R. R. & Banking Co. of Georgia.
Central Railroad of New Jersey.
Central Vermont.
Champaign & Havana.
Chattanooga, Rome & Columbus.
Chattanooga Southern.
Chesapeake, Ohio & South-Western.
Chesapeake & Ohio.

Chesapeake & Western.
Chicago, Burlington & Kansas City.
Chicago, Burlington & Northern.
Chicago, Burlington & Quincy.
Chicago, Cincinnati & Louisville.
Chicago, Fort Madison & Des Moines.
Chicago Great Western.
Chicago, Indianapolis & Louisville.
Chicago Junction.
Chicago, Kalamazoo & Saginaw.
Chicago, Lake Shore & Eastern.
Chicago, Milwaukee & St. Paul.
Chicago, New York & Boston Refrigerator Co.
Chicago, Peoria & St. Louis.
Chicago Refrigerator Car Co.
Chicago, Rock Island & Pacific.
Chicago, St. Louis & Pittsburgh.
Chicago, St. Paul, Minneapolis & Omaha.
Chicago Terminal Transfer.
Chicago Union Transfer.
Chicago & Alton.
Chicago & Eastern Illinois.
Chicago & Erie.
Chicago & Iowa.
Chicago & Milwaukee Electric.
Chicago & North-Western.
Chicago & South Bend.
Chicago & Western Indiana and Belt Railway.
Chihuahua & Pacific.
Choctaw, Oklahoma & Gulf.
Cincinnati, Hamilton & Dayton.
Cincinnati, Selma & Mobile.
Cincinnati Northern.

Cincinnati Southern.
Cincinnati, New Orleans & Texas Pacific.
Cleveland, Akron & Columbus.
Cleveland, Cincinnati, Chicago & St. Louis.
Cleveland & Marietta.
Cleveland, Canton & Southern.
Cleveland, Lorain & Wheeling.
Cleveland Terminal & Valley.
Clove Branch.
Coal & Coke.
Cold Blast Transportation Co
Colorado & Southern.
Colorado & South-Eastern.
Colorado & Wyoming.
Colorado Midland.
Colorado Springs & Cripple Creek District.
Columbia & Puget Sound.
Columbus, Hocking Valley & Toledo.
Connecticut River.
Consolidated Cattle Car Co.
Consolidated Rolling Stock Co.
Continental Fruit Express.
Cornwall.
Cornwall & Lebanon.
Corsicana Cotton Oil Co.
Corvallis & Eastern.
Craig Oil Co.
Crystal Car Line.
Cudahy Refrigerator Line.
Cumberland Valley.
Cumberland & Pennsylvania.
Dairy Shippers' Despatch.
Delaware, Lackawanna & Western.

Delaware River & Union.
Delaware, Susquehanna & Schuylkill.
Delaware & Hudson Co.
Delray Connecting.
Denver & Rio Grande.
Detroit, Toledo & Milwaukee.
Detroit & Lima Northern.
Detroit & Mackinac.
Des Moines & Fort Dodge.
Des Moines & Northern.
Dolese & Shepard.
Dominion Atlantic.
Doud Stock Car Co.
Dry Fork.
Duluth & Iron Range.
Duluth, Missabe & Northern.
Duluth, South Shore & Atlantic.
Durham & Northern.
Eagle Oil Co.
East & West.
Elgin, Joliet & Eastern.
Elizabeth River.
Elmira, Cortland & Northern.
El Paso & Southwestern.
Empire Oil Works.
Erie.
Erie & Michigan Ry. & Nav. Co.
Erie & Wyoming Valley.
Esquimalt & Nanaimo.
Evansville & Terre Haute.
Express Coal Line.
Fairbank Co., The N. K.
Fall Brook.

Findlay, Fort Wayne & Western.
Fitchburg.
Florence & Cripple Creek.
Florida Central & Peninsular.
Florida Central.
Florida East Coast.
Fort Smith & Western.
Fort Worth Belt.
Fort Worth & Denver City.
Freedom Oil Works.
Galveston, Harrisburg & San Antonio.
Geneva, Ithaca & Sayre.
George's Creek & Cumberland.
Georgia.
Georgia, Carolina & Northern.
Georgia Southern & Florida.
German-American Car Co.
German-American Refrigerator Express.
German-American Tank Line.
Gila Valley, Globe & Northern.
Golden Circle.
Goodwin Car Co.
Grand Rapids & Indiana.
Grand Trunk Railway System.
Great Northern Railway Line.
Great Western Oil Refg. Co.
Green Bay & Western.
Gulf, Colorado & Santa Fe.
Gulf, Western Texas & Pacific.
Guyton, W. A. & Co.
Hannibal & St. Joseph.
Hartford & Connecticut Western.
Hecla Belt Line.

Heinz, H. J., & Co.
Higgins Oil & Fuel Co.
Higley Co. Refrigerator Line.
Housatonic.
Houston East & West Texas.
Houston & Texas Central.
Huntington & Broad Top Mountain.
Hutchinson & Southern.
Illinois Central.
Illinois, Iowa & Minnesota.
Illinois Southern.
Imperial Oil Co. Ltd.
Indiana, Bloomington & Western.
Indianapolis, Decatur & Western.
Indiana Harbor.
Indiana, Illinois & Iowa.
Indiana Pipe Line & Refining Co.
Intercolonial of Canada.
International & Great Northern.
Interstate.
Iowa Central.
Iron Car Express Coal Line.
Jacksonville & St. Louis.
Jacob Dold Packing Co.
Jamison Coal & Coke Co.
Kanawha & Michigan.
Kansas City, Fort Scott & Memphis.
Kansas City, St. Joseph & Council Bluffs.
Kansas City, Memphis & Birmingham.
Kansas City, Mexico & Orient.
Kansas City Southern.
Kentucky Refining Co.
Keokuk & Western.

Keystone Palace Horse Car Co.
Kilpatrick Bros. & Collins Contracting Co.
Knapp, I. N.
Lackawanna Coal & Coke Co.
Lackawanna Iron & Steel Co.
Lackawanna Steel Co.
Lake Carrier's Oil Co.
Lake Champlain & Moriah.
Lake Erie & Detroit River.
Lake Erie & Western.
Lake Shore & Michigan Southern.
Lake Superior & Ishpeming.
Lake Terminal.
Leavenworth, Kansas & Western.
Leetonia.
Lehigh & Hudson River.
Lehigh & New England.
Lehigh Valley.
Lexington & Eastern.
Litchfield & Madison.
Litchfield, Carrollton & Western.
Live Poultry Transportation Co.
Louisiana & Arkansas.
Louisiana & Northwest.
Louisiana Railway & Navigation Co.
Louisiana Western.
Louisville Cotton Oil Co.
Louisville & Nashville.
Louisville, New Orleans & Texas.
Louisville Soap Co.
Louisville, St. Louis & Texas.
Louisville & St. Louis.
Lutz & Schramm Co.

McCloud River.
Macon & Birmingham.
Madison, Alton & Chicago.
Mahoning Valley.
Maine Central.
Manhattan Oil Co.
Manistee & Grand Rapids.
Manistee & North-Eastern.
Manitoba & North-Western Ry. of Canada.
Maricopa & Phoenix & Salt River Valley.
Manufacturers' Junction.
Marietta, Columbus & Cleveland.
Marquette & Southeastern.
Martin, John C.
Marshalltown & Dakota.
Mason City & Fort Dodge.
Mather Stock Car Co.
Mercer Valley.
Mexican Central.
Mexican International.
Mexican Northern.
Michigan Ammonia Works.
Michigan Central.
Midland Valley.
Midland Terminal.
Miller's Sons' Co., A. D.
Milwaukee, Lake Shore & Western.
Mineral Point Zinc Co.
Minneapolis, St. Paul & Sault Ste. Marie.
Minneapolis & St. Louis.
Minnesota & International.
Mississippi Central.
Mississippi River & Bonne Terre.

Mississippi River, Hamburg & Western.
Missouri Pacific.
Missouri & North Arkansas.
Missouri, Kansas & Texas.
Mobile & Birmingham.
Mobile & Ohio.
Mobile, Jackson & Kansas City.
Monongahela Connecting.
Monongahela River Consol. Coal & Coke Co.
Montana Union.
Monte Cristo.
Mooney Car Line Co.
Morgan's Louisiana & Texas Railroad & Steamship Co
Morganstown & Kingwood.
Morrisey, Fernie & Michel.
Morton-Gregson Car Lines.
Munising.
Nacozari.
Nashville, Chattanooga & St. Louis.
National Ammonia Co.
National Car Co.
National Car Line.
National Rolling Stock Co.
Nelson Morris & Co.
Newburgh, Dutchess & Connecticut.
New Orleans & North-Eastern.
Newport News & Mississippi Valley.
New York Central & Hudson River.
New York & Northern.
New York & Ottawa.
New York, Chicago & St. Louis.
New York, New Haven & Hartford.
New York, Ontario & Western.

New York, Pennsylvania & Ohio.
New York, Philadelphia & Norfolk.
New York, Providence & Boston.
New York & New England.
New York, Susquehanna & Western.
New York, Texas & Mexican.
Norfolk Southern.
Norfolk & Carolina.
Norfolk & Portsmouth Belt Line.
Norfolk & Western.
Northern Central.
Northern Pacific.
Old Colony.
Ohio Southern.
Ohio & Mississippi.
Ogdensburg & Lake Champlain.
Omaha & St. Louis.
Oregon Electric.
Oregon Railroad & Navigation Co.
Oregon Short Line.
Overland Refrigerator Express.
Paragon Refining Co.
Parral & Durango.
Penn Gas Coal Co.
Pennsylvania Coal & Coke Co.
Pennsylvania Co.
Pennsylvania Railroad.
Pennsylvania, Poughkeepsie & Boston.
Pennsylvania & North-Western.
Peoria, Decatur & Evansville.
Pere Marquette.
Petersburg.
Philadelphia & Reading.

Philadelphia, Wilmington & Baltimore.
Pittsburgh, Akron & Western.
Pittsburgh, Chartiers & Youghiogheny.
Pittsburgh, Cincinnati, Chicago & St. Louis.
Pittsburgh Coal Co.
Pittsburg, Shawmut & Northern.
Pittsburg Provision & Packing Co.
Pittsburgh & Buffalo Co.
Pittsburgh & Eastern.
Pittsburgh & Lake Erie.
Pittsburgh & Western.
Plant System.
Pontiac, Oxford & Northern.
Portland & Rumford Falls.
Produce Shippers' Despatch.
Producer's Pipe Line Co.
Providence & Worcester.
Provision Dealers' Despatch.
Quebec & Lake St. John.
Quebec, Montreal & Southern.
Raleigh & Augusta Air Line.
Raleigh & Gaston.
Rio Grande, Sierra Madre & Pacific.
Richmond, Fredericksburg & Potomac.
Rio Grande Western.
Rock Island & Peoria.
Rome, Watertown & Ogdensburg.
Roanoke & Tar River.
Rutland.
Saginaw Valley & St. Louis.
Saint Clair Terminal.
San Antonio & Aransas Pass.
San Pedro, Los Angeles & Salt Lake.

Santa Fe Central.
Santa Fe Pacific.
Santa Fe, Prescott & Phoenix.
Santa Fe Refrigerator Despatch.
Scioto Valley.
Seaboard & Roanoke.
Seattle & International.
Shenandoah Valley.
Sherman, Shreveport & Southern.
Shippers Refrigerator Car Co.
Sierra Ry. Co. of California.
South Buffalo.
South Carolina.
South-Eastern Line.
South Florida.
Southwestern of Arizona.
Southern.
Southern Central.
Southern Freight Line.
Southern Indiana.
Southern Iron Car Line.
Southern Oil Co.
Southern Pacific (Pacific System).
Spokane & Inland Empire.
Spokane Falls & Northern.
Spokane International.
Spokane, Portland & Seattle.
St. Joseph, South Bend & Southern.
St. Joseph & Grand Island.
St. Louis, Brownsville & Mexico.
St. Louis Car Co. Line.
St. Louis, Chicago & St. Paul.
St. Louis Dressed Beef & Provision Co.

St. Louis, Kansas City & Colorado.
St. Louis, Keokuk & North-Western.
St. Louis, Peoria & Northern.
St. Louis Refrigerator Car Co.
St. Louis, Rocky Mountain & Pacific.
St. Louis South-Western.
St. Louis South-Western Railway of Texas.
St. Louis Transfer.
St. Louis, Troy & Eastern.
St. Louis & Hannibal.
St. Louis & O'Fallon.
St. Louis & San Francisco.
St. Paul & Duluth.
Staten Island Rapid Transit.
Street's Western Stable Car Line.
Susquehanna & New York.
Swift & Co.
Swift Refrigerator Transportation Co.
Swift Live Stock Express Line.
Sydney & Louisburg.
Tacoma Eastern.
Tehuantepec National.
Temiskaming & Northern Ontario.
Tennessee Copper Co.
Texas & New Orleans.
Texas Brewing Co.
Texas Central.
Texas Company.
Texas Pacific.
Tionesta Valley.
Toledo, Cincinnati & St. Louis.
Toledo, Columbus & Cincinnati.
Toledo, Peoria & Western.

Toledo, St. Louis & Western.
Toledo Terminal.
Toledo & Ohio Central.
Toledo & Ohio Central Extension.
Toledo & Western.
Tonopah & Goldfield.
Tonopah & Tidewater.
Toronto, Gray & Bruce.
Toronto, Hamilton & Buffalo.
Tremont & Gulf.
Trinity & Brazos Valley.
Troy & Boston.
Tyler South-Eastern.
Union.
Union Pacific.
Union Refrigerator Transit Co.
Union Stock Yards & Transit Co. of Chicago.
Union Stock Yards Co. of Omaha.
Union Tank Line.
United Coal, Co.
Vandalia.
Vera Cruz & Pacific.
Vicksburg, Shreveport & Pacific.
Vinton Colliery Co.
Virginia.
Virginia & Southwestern.
Wabash Railway.
Walworth & Neville Mfg. Co.
Washington Coal & Coke Co.
Washington Southern.
Waters Pierce Oil Co.
Wheeling & Lake Erie.
Western Car Co.

Western Live Stock Express.
Western Maryland.
Western Railway of Alabama.
Western New York & Pennsylvania.
Western Rolling Stock & Equipment Co.
West Jersey & Sea Shore.
West Shore.
West Side Belt.
West Virginia Central & Pittsburg.
Williamsville, Greenville & St. Louis.
Wilmington & Northern
Wisconsin Central.
Wisconsin & Northern.
Yellowstone Park.
Zanesville & Ohio River.
Zanesville & Western.

APPENDIX.

CODE OF RULES

GOVERNING THE CONDITION OF, AND REPAIRS TO, PASSENGER EQUIPMENT CARS IN INTERCHANGE.

PREFACE.

***These** rules make car owners responsible for, and therefore chargeable with, the repairs to their cars necessitated by ordinary wear and tear in fair service, so that defect cards will not be required for any defects thus arising.*

***Railroad** companies handling cars are responsible for damage done to any car by unfair usage, derailment or accident, and for improper repairs made by them, and they should make proper repairs at their own expense, or issue defect card covering all such damage or improper repairs.*

All inspection of passenger cars for interchange will be made in accordance with the following rules:

1. Each Railway Company shall give to foreign cars, while on its line, THE SAME CARE AS TO OILING, PACKING AND INSPECTION THAT IT GIVES ITS OWN CARS, except in case of cars on which work is done under special agreement existing between the company owning the cars and the road operating the same.

2. The expenses of maintenance of passenger equipment operated in interchange or line service, shall be divided into three classes, namely:

(a) Owner's defects.

(b) Delivering Company's defects.

(c) Line expenses proratable against the roads comprising the lines on a mileage basis.

3. (a) Owner's defects are those due to ordinary wear and tear.

(b) Delivering company's defects are those due to unfair usage, derailment or accident. Delivering company is solely responsible to car owners for any improper repairs made by them.

(c) Line expenses shall consist of the expense of terminal cleaning, lubrication (oil, waste, tallow and labor), lighting (oil, wicks, chimneys, burners, shades, gas, candles and broken glass).

4. The railway making the repairs for the defects not proratable against the line is privileged to bill the car owner for these repairs, unless there is evidence to indicate that the damage was occasioned by unfair handling on the part of the delivering company.

5. Information as to mileage made by cars must be furnished promptly on request of owners by railways over which cars are run.

6. Only one journal bearing per journal may be charged per trip.

7. No labor charge shall be made for applying brake shoes, journal bearings, hose (air, steam or signal) or for icing, filling lamps, gassing tanks or coaling cars.

8. No credit to be allowed for scrap brake shoes *removed.*

Note.—Steel back brake shoes not to be removed if over one-half (½) inch thick; grey iron shoes not to be removed if over three-quarter (¾) inch thick.

9. Loss of metal from tires of steel-tired wheels, caused by flat sliding, is chargeable to the company on whose road the damage occurs.

NOTE.—Loss of service metal from steel-tired wheels as a result of sliding to be measured from point where slide begins. One-sixteenth (1-16) inch of metal to be allowed for flat spots under two and one-half (2½) inches long and one-eighth (⅛) inch of metal to be allowed for flat spots two and one-half (2½) to three and one-half (3½) inches in length, both inclusive.

10. (a) Axles broken under fair usage or having journals one-half (½) inch or more under the standard for car (except for three and three-quarters by seven [3¾ by 7], which will be condemned at three and one-half [3½] inches) may be renewed at the expense of the car owner. Size of journal should be stenciled on truck.

(b) Cut journals, axles bent or broken or rendered unsafe by unfair usage, derailment or accident, shall be renewed at the expense of the railway on whose line the damage occurs.

(c) Where necessary to true up axles in cases of cut journals, where the journal is reduced below the limit as prescribed in Rule 10*a*, axle must be changed at the expense of company cutting journal.

Charge for car heating to be 15 cents per day per car.

11. Cars lying at stations for over forty-eight hours, expense of heating to be borne by railway in whose possession cars may be.

12. (a) Brakes must be in perfect working order. Cylinders and triple valves must have been cleaned and

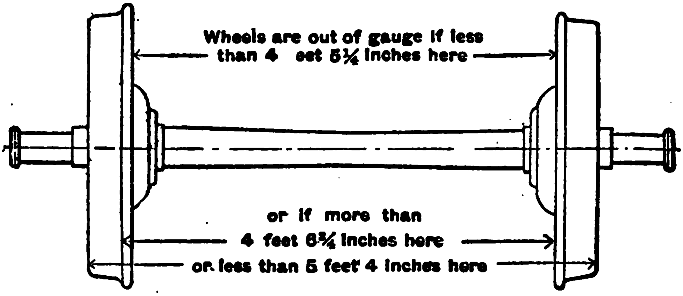
oiled within six (6) months, and in case of cars equipped with high-speed brakes, triple and high-speed valves must be cleaned every three (3) months and date of last cleaning and oiling stenciled on brake cylinder and triple valve with white paint.

(b) The adjustment of piston travel based on not less than seventy (70) pounds initial pressure must not be less than five (5) inches nor more than eight (8) inches.

DEFECTS IN WHEELS—OWNERS RESPONSIBLE.

13. (a) Loose wheels.

(b) Variation from gauge if less than 4 feet 5¼ inches inside of wheel at flange, or if more than 4 feet 6¾ inches outside of flange or less than 5 feet 4 inches outside of tread.


Wheels are out of gauge if less than 4 feet 5¼ inches here
or if more than 4 feet 6¾ inches here
or less than 5 feet 4 inches here

WHEELS—CAST-IRON.

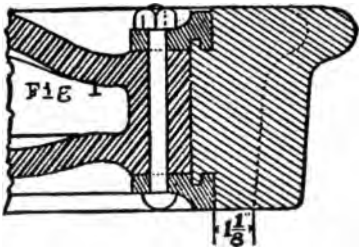
14. (a) Shelled out; wheels with defective treads on account of pieces shelling out; if the spots are over one *(1) inch or so* numerous as to endanger the safety of the *wheel.*

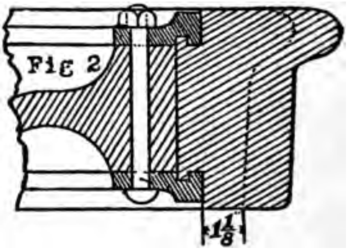
(b) Tread worn hollow; if tread is worn hollow ⅛ h *or over.*

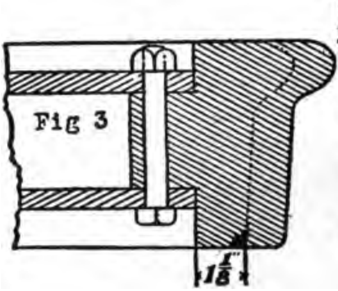
(c) Worn flanges; flanges having flat vertical surfaces extending more than ¾ inch from tread, or flanges less than 1⅛ inches thick.

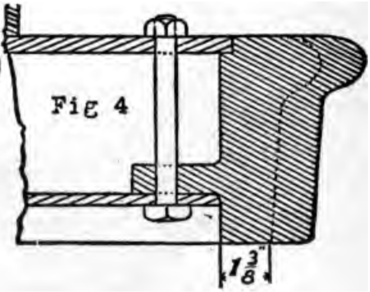
(d) Burst; if wheel is cracked from wheel fit outward by pressure from axle.

(e) Flange, rim, tread, plate brackets or any other part of wheel, either cracked, chipped or broken under fair usage.









WHEELS—STEEL-TIRED.

15. (a) Loose, broken or cracked hubs, plates, bolts, retaining ring or tire, occurring under fair usage.

(b) Worn flange or tire; with flange 1 inch thick or less, or having flat vertical surfaces extending more than

1 inch from tread (see Figs. 4 and 4*a*) or with tire thinner than shown in Figs. 1, 2, 3, 4, 5 and 6 following.

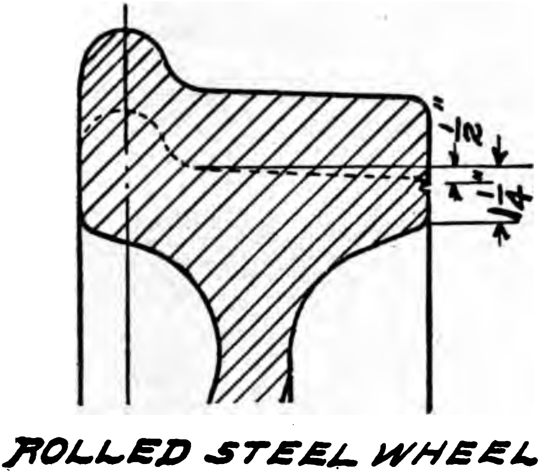


Fig. 5.

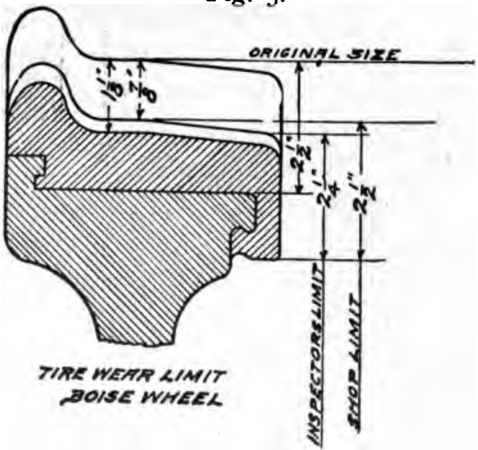


Fig. 6.

DELIVERING COMPANY RESPONSIBLE.

16. Flat spots; if flat spots, caused by sliding, exceed one inch in length.

17. (a) If a car is transferred from the service of one railroad to that of another, the receiving road shall issue gas certificate authorizing the delivering road to bill against it for the number of atmospheres of gas and number of holders at the time car was received.

(Name of Road.)
GAS CERTIFICATE.

....

Car Number .... Initial ....

Number of Atmospheres ....

Number of Holders ....

Size of Holders ....

.... Station, ...190

..............................Inspector.

(b) Cars in interchange requiring holders to be filled, the receiving road shall be charged for the quantity of gas supplied.

(c) For cars stored in shops for repairs the company having car in its possession shall be responsible to the delivering company for the gas in holders. This will apply to sleeping car companies when cars are in their possession and out of service.

(d) Private or other cars, except regular line cars, when offered in interchange equipped with steam hose couplings that will not couple with the standard on the receiving line must be changed by receiving company; the hose removed to accompany car or be returned to delivering company.

18. The depreciation of all passenger equipment cars due to age shall be figured at 3 per cent per annum upon the yearly depreciated value of same, to continue not to exceed 50 per cent of its original value. The above method of depreciation applies equally to either bodies or trucks of such cars. No depreciation shall be allowed on the value of air brakes.

19. This code of rules is to apply to all equipment interchanged in passenger trains.

20. Bills for line charges shall be made and rendered monthly and prices for materials and labor shall be in accordance with accompanying schedule.

21. Air-brake hose applied subsequent to September 1, 1906, must be made in accordance with M. C. B. specifications and so labeled.

22. This Code of Rules shall take effect September 1, 1908.

LIST OF PRICES FOR MAINTENANCE OF PASSENGER EQUIPMENT IN INTERCHANGE.

1	Axles, 5 by 9 inches, new, $17.75; second-hand, $10.00; scrap, $6.50. Axles, 4¼ by 8 inches, new, $14; second-hand, $7.75; scrap, $5.25. Axles, 3¾ by 7 inches, new, $11.50; second-hand, $6.25; scrap, $4.25.	
2	Burners, round wick, each	$0.50
3	Burners, dual wicks, each	.30
4	Bell or signal cord and couplings, per car	.75
5	Bearings, journal, applied, per lb	.20
6	Bearings, journal, credit for scrap bearing one-half weight of new bearing, per lb	.15
7	Bolts, nuts and forgings, per lb	.03
8	Bolts, nuts and forgings, credit, per lb	.00¾
9	Bowls, opal, gas, 9-inch, each	.50
10	Chimneys, round wick, each	.11
11	Chimneys, dual wick, each	.06
12	Candles, per lb	.15
13	Coal (including labor), per ton	6.00
14	Chain, per lb	.05
15	Chain, credit, per lb	.01
16	Cleaning parlor and sleeping cars, exclusive of bedding, per car	1.35
17	*Cleaning* vestibuled passenger and combination cars, each	.85
18	*Cleaning* common passenger and combination cars, each	.50
19	*Cleaning* vestibuled baggage and mail cars, each	.50
20	*Cleaning* common baggage and mail cars, each	.30

21	Taking out carpets, seats, draperies, etc., from parlor and sleeping cars and beating them, per car	$1.00
22	Taking out and beating cushions and backs of seats of passenger cars, either vestibuled or common, per car	.65
	(No additional charge for cleaning trucks of parlor or sleeping cars.)	
23	Domes, gas, each	.50
24	Diamond S. brake shoes, applied, each, no credit for scrap	.50
25	Gas, Pintsch, per receiver	.85
26	Globes, gas, 4-inch, each	.50
27	Globes, opal, gas, each	.50
28	Glass, per light	At Cost
29	Glass, setting, per light	.25
30	Hose, air-brake or signal, complete with fittings, applied to car, each:	
	1-inch air signal	1.75
	1¼-inch air brake	2.00
31	Hose, air brake or signal, credit for fittings	.80
32	Hose, 1½-inch straight port, steam, complete with fittings, applied to car	6.50
	Hose, as above, 1-inch	5.00
33	Hose, 1½-inch steam, credit for fittings	5.25
	Hose, as above, 1-inch	4.00
34	Ice (including labor), per cwt	.30
35	Iron, cast, per lb	.02
36	Iron, cast, credit, per lb	.006-10
37	Iron, malleable, per lb	.03½
38	Iron, malleable, credit, per lb	.00½
39	Labor, on lubrication, per hour	.24
40	Labor, on repairs, per hour	.30
41	Lumber, oak, pine, hickory, poplar and elm, per ft	.03½
42	Oil, Galena, car, per gal	.22
43	Oil, Galena, coach, per gal	.35
44	Oil, illuminating, American roads to charge, per gal	.11
45	Oil, illuminating, Canadian roads to charge, per gal	.16
46	Shades, acme lamp, each	.45
47	Shades, common lamp, each	.25
48	Steel, spring (not springs), per lb	.05
49	Steel, spring, credit, per lb	.00¾
50	Steel castings, per lb	.04½
51	Steel castings, credit, per lb	.00¾
52	Tallow, per lb	.06
53	Waste, woolen, per lb	.12½
54	Waste, cotton, per lb	.06
55	Wicks, round, each	.02
56	Wicks, dual, each	.00½
57	Wheels, cast, 36-inch, new, $10.50; second-hand, $7.75; scrap, $5.25.	
58	Wheels, cast, 33-inch, new, $9.00; second-hand, $7.00; scrap, $4.75.	
59	Wheels, new, steel	Cost
60	Loss of metal from steel-tired wheels, $2 per 1-16 inch.	
61	Labor, changing, per pair	2.00
62	Removing, turning and replacing steel-tired wheels	7.00
63	Steel-tired, cost of retiring to be cost with the addition of freight charges.	

LIST OF RAILROAD COMPANIES.

The following is a complete list of the railroad companies which have given notice of the adoption of the Code of Rules for the interchange of passenger equipment cars:

Arizona & South-Eastern.
Atlantic, Valdosta & Western.
Baltimore & Ohio.
Bangor & Aroostook.
Boston & Albany.
Boston & Maine.
Burlington, Cedar Rapids & Northern.
Butte, Anaconda & Pacific.
Cairo, Vincennes & Chicago.
Canadian Pacific.
Central Vermont.
Chesapeake & Ohio.
Chicago & Erie.
Chicago & North-Western.
Chicago, Burlington & Kansas City.
Chicago, Burlington & Quincy.
Chicago, Milwaukee & St. Paul.
Chicago, Rock Island & Pacific.
Choctaw, Oklahoma & Gulf.
Cincinnati, Hamilton & Dayton.
Cincinnati, New Orleans & Texas Pacific.
Cleveland, Cincinnati, Chicago & St. Louis.
Cleveland, Lorain & Wheeling.
Cleveland Terminal & Valley.

Colorado & Southern.
Cornwall & Lebanon.
Delaware, Lackawanna & Western.
Denver & Rio Grande.
Detroit, Toledo & Milwaukee.
Detroit & Lima Northern.
Erie.
Fitchburg.
Florida Central & Peninsular.
Florida East Coast.
Fort Worth & Denver City.
Golden Circle.
Grand Rapids & Indiana.
Grand Trunk Railway System.
Green Bay & Western.
Hannibal & St. Joseph.
Hutchison & Southern.
Illinois Central.
Kanawha & Michigan.
Kansas City Southern.
Kansas City, St. Joseph & Council Bluffs.
Lake Shore & Michigan Southern.
Lehigh Valley.
Louisiana & Arkansas.
Manitoba & North-Western Railway of Canada.
Mason City & Fort Dodge.
Midland Valley.
Minneapolis & St. Louis.
Mississippi & Bonne Terre.
Mississippi River, Hamburg & Western.
Missouri Pacific.
Mobile & Birmingham.
Nacozari.